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# BUREAU OF PUBLIC WORKS

# Quarterly Bulletin

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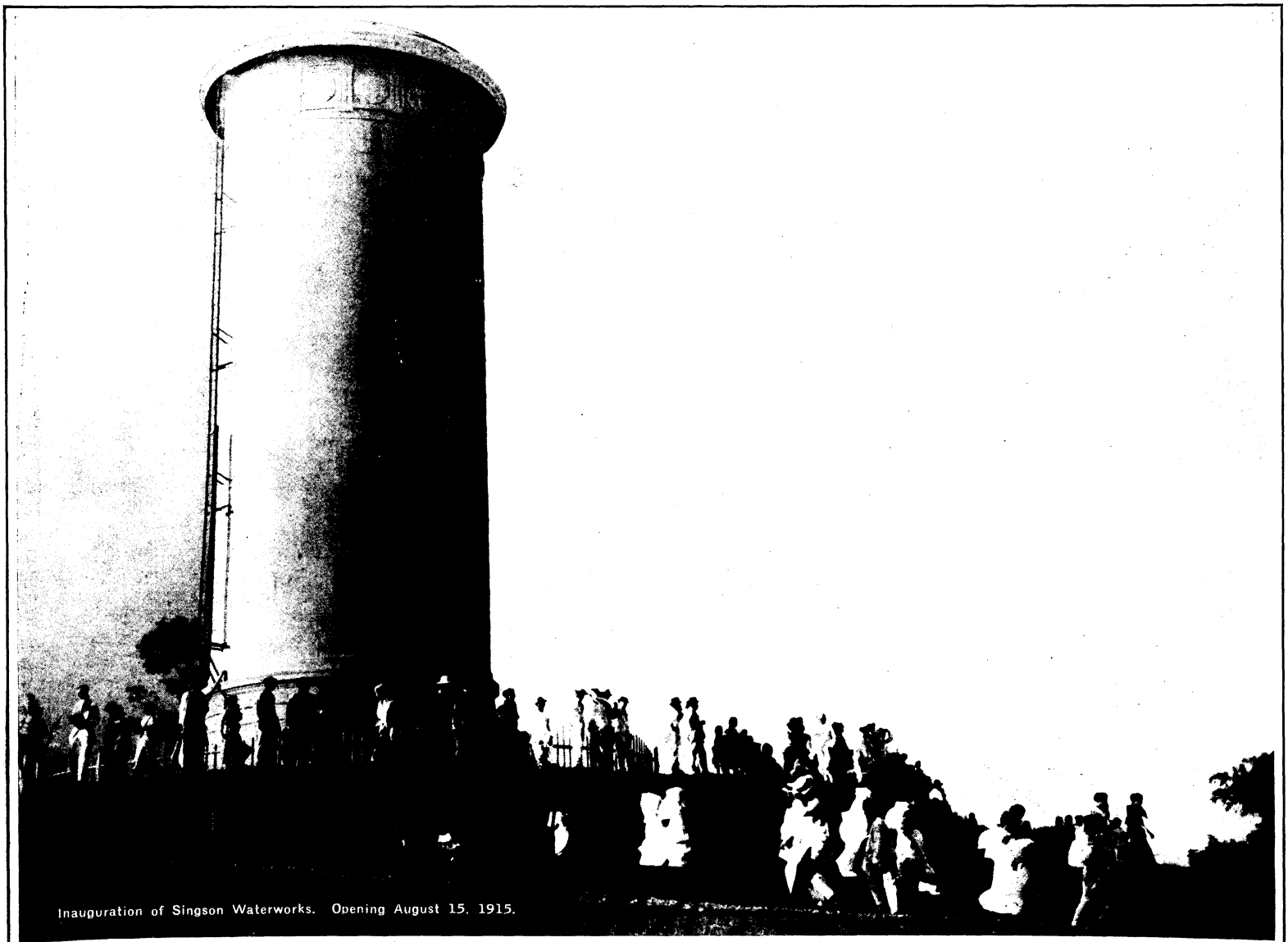

Inauguration of Singson Waterworks. Opening August 15, 1915.

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# QUARTERLY BULLETIN

BUREAU OF PUBLIC WORKS
MANILA, P. I.

ISSUED QUARTERLY BY
THE CONSTRUCTING DIVISION, UNDER THE DIRECTION OF
THE DIRECTOR OF PUBLIC WORKS

C. A. TANSILL, COMPILER OF STATISTICS


The objects of the QUARTERLY BULLETIN are:

1. To show each engineer and employee of the Bureau of Public Works the work of the Bureau as a unit.
2. To show him that his work is a unit part of the whole.
3. To make clear to every provincial and municipal official and to the people the work being done by the Bureau.
4. To make the work of the Bureau of personal interest to all.

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## LICENSE.

The yellow dog is licensed
He wears a metal tag;
The bar-keep buys a license
To sell a man a jag.
The peddler needs a license
To peddle out his wares,
And the hackman has a license
To haul around his fares.
The motor car is licensed
By State and city, too;
The barber gets a license
And hangs it up to view.
The architect is licensed
And stamps it on his plans,
And my poetic license
Is as good as any man's.
Most everybody's licensed,
And the time is drawing near
When a fifty-dollar license
Will make an engineer.

*—Engineering and Contracting, September 29, 1915.*

## IRRIGATION.

In public-works operations in these Islands, perhaps the most backward are those appertaining to irrigation development. In the activities of the Bureau of Public Works, it is admitted that the data relative to the design of hydraulic works are insufficient and incomplete. Data should cover a period of years which should be inclusive of both wet and dry cycles. If a design were based upon a dry cycle, without any knowledge of a wet cycle, the design probably would be improper and insufficient. The original design of the dam in the Montalban Gorge, which impounds the water supply of the city of Manila is an illustration. After the design was completed, additional flood data were secured which indicated conclusively that the original design should be amended to provide the additional strength necessary. These data developed while the engineers were awaiting the funds upon which construction was to be based. The construction of the first dam at San Miguel, Tarlac, is another illustration of the going ahead upon insufficient data. This lack of preparedness cost the Insular Government a great many thousands of pesos. The low grade of the original Benguet Road and other projects may be cited as having been based upon insufficient data. Correct engineering procedure will not permit the design of irrigation works unless the run-off of the stream is known. This knowledge can only be obtained from a study of several years. A building may be designed properly if the amount to be expended and the supporting power of the soil is known. Both are easy of determination. A road may be built and a flood may carry a portion of it away with comparatively unimportant damage or disarrangement of the social and economic relationship of the people. If a waterworks is built for a town, or if a territory is developed through irrigation, a cessation of the flow of water affects almost with the force of destruction.

It has been noted that it is asserted that the irrigation laws of these Islands require too much red tape to become effective. The undersigned holds no brief for these laws, but, knowing where the real shortcoming rests, he believes it to be proper, and to be his duty, to state where the difficulty lies. No law can be made effective unless there are those available to meet its requirements and enforce its provisions. Every application for a water right should be investigated thoroughly and promptly. There is insufficient personnel to do this. Additional personnel must be authorized if the applications for water rights are to be disposed of promptly and properly. A water-right application should be clear and definite as to the land to be irrigated and the place of diversion. In the absence of surveys and surveyors, this definiteness cannot be had. If a water-right application is ambiguous or indefinite it must be returned for correction or additional data. This is not the fault of the law, but of the applicant. If a water-right application affects a stream the flow of which is unknown, hydrographers must be employed to determine the flow. If there is sufficient water and the granting of a water-right is feasible, engineers must be had who can inspect the site of the proposed works and determine the suitableness of the design proposed.

The development of irrigation in these Islands has been defective through legal deficiencies. An illustration of the lack of legal study is the San Miguel irrigation project. So long as the proper legal assistance is not had, proper irrigation development will not obtain. The engineer and the lawyer are required; but the engineer must dominate, as irrigation is essentially an engineering and not a legal proposition. A lawyer is as necessary to the entity determining irrigation questions as he is to a great corporation. This attorney must be closely and intimately associated with the directing engineer. Because of the complexities and wide range of the questions that are usually presented, it is the opinion of the undersigned that the best legal mind of the Islands would be none too good for the job. The undersigned knows of a certain national undertaking of irrigation development where the expenditures have been several hundred million pesos and where the foundations of the projects constructed were not based legally. To-day confusion, disorganization, and discredit obtains. Lawyers were employed, but they had little or no experience, the salaries paid them were small, and their opinions have not stood against the public.

To properly design irrigation systems, several years data of

run-off are necessary. In Java, for small projects, five years is regarded as the minimum period for hydraulic data on which designs are based; and for the important projects a period of ten years is regarded as necessary for the collection of reliable data on rainfall, stream discharge, floods, etc. In India, ten years is considered as a minimum period for the collection of data. In the United States, the Government has not undertaken the construction of a project except after its feasibility had been determined from several years run-off data. These data are as essential in the Philippines as they are in Java, India, and the United States. These data should be taken continuously and not intermittently.

It must be understood that water for irrigation is real estate and is so termed in law here. It must be recalled that after a decade and a half there is comparatively little cadastral survey work completed and titles secured. After about twelve years, it was found that the legal equipment was entirely inadequate to meet the demands and a number of additional judges were provided for and appointed. More help is what is needed to facilitate and expedite the application of the present irrigation law, precisely as more help was needed to expedite and facilitate land registration.

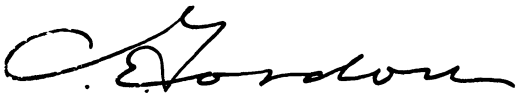
It takes, it has taken, and it will continue to take, years to procure Torrens title to the land real estate. These titles are based upon surveys. Titles could not pass properly, unless such definiteness was provided. As irrigation water is real estate, as it is appurtenant to the land, the same definiteness should be had with it as with land. The more the definiteness, the greater and more painstaking the investigation, the better should be the title to the appurtenant water. Legal processes do not pass to a termination in a day. If it has taken years to attain scarcely more than a beginning in the obtainment of land titles, as the application of the irrigation laws are slow, as both land and water titles are practically the same, if the irrigation laws are defective the Torrens title laws are defective, and if the latter are not defective, the shortcoming must be found elsewhere than in the law. As water is appurtenant to the land, it would seem that the title to the land should precede the granting of a title to water to irrigate that land. Generally, the Bureau of Public Works has recommended the granting of water titles before the titles to the lands to be watered have passed and before these lands have even been surveyed. This, in the opinion of the undersigned, is not sound, but is done because of the exigencies of the land-registration question, and a desire not to impede in any way the development of the country.

It has been noted that the development of small irrigation systems has been advocated. It is the opinion of the undersigned that the construction of small irrigation systems will result in the uneconomical expenditure of funds. Engineering costs will be found to be extremely high. If small project construction should be permitted, ad libitum, their encroachment upon the really feasible large projects would render the construction of the large projects as out of the question, because of interference. In such cases, it might be possible to irrigate, say, 2,000 hectares through small projects, and destroy the possibility of irrigating 10,000 hectares, as well as permit the continual wastage of a large volume of water. Such a procedure would be contrary to conservation principles. The question is exactly similar to the occupation of a power site by a small mill where there is power sufficient to drive a large mill.

If any irrigation development, by the Government, is to be accomplished in the very near future, it will necessitate going ahead without sufficient data as to the water supply. If irrigation works are desired, hydrographers must be authorized, procured, and directed to obtain the data so essential. The time necessary to obtain the needed data may not cause a delay in construction due to insufficient data, as no system of irrigation should be considered without the determination of the prior rights on the stream or streams to be utilized, and such determination usually occupies considerable time.

Summarizing the above, the undersigned would emphasize that any system constructed before the adjudication of water rights upon a stream where prior rights are in existence is likely to become unsatisfactory and lacking in sufficient water supply at a critical time. Moreover, the administration of unadjudicated waters is productive of endless disputes. The effect of the lack of knowledge in these matters is well known among irrigation engineers and administrators of irrigation systems. Attention is requested to the fact that sound irrigation policy demands that irrigation development should be based upon adequate investigation of all the essential and pertinent facts, and such investigation requires considerable time. The undersigned could not indorse any legislation that did not include the principles above set forth.

To be brief, in the opinion of the undersigned irrigation development by the Government can be successful only with (1) adequate funds, (2) adequate technical personnel, (3) adequate data, (4) adequate legal aid.



## WATER RIGHTS.

By J. A. Beemer, C. E.

In the following article the writer attempts to deal with this subject from the standpoint of the practical application of the Irrigation Act to matters pertaining to water rights in the Philippines.

On February 6, 1912, the Second Philippine Legislature passed Act No. 2152, the Irrigation Act, governing the appropriation and use of the public waters in the Philippine Islands. This Act incorporates the Spanish Law of Waters of August 3, 1866, which continues in force in so far as it is not incompatible with the provisions of the Irrigation Act.

### POWER TO GRANT APPROPRIATIONS.

According to section 2 of the Irrigation Act the power to grant appropriations of public waters is vested in the Secretary of Commerce and Police upon the recommendation and approval of the irrigation council. Executive Order No. 3, dated January 20, 1915, authorizes the Director of Public Works to exercise such powers and perform such duties in the Department of Mindanao and Sulu as are vested in him by the general laws in force in the Philippine Islands. In an opinion dated September 16, 1915, relative to the granting of a water right in a non-Christian province, the Attorney-General states: "As Act No. 2152 of the Philippine Legislature does not seem to have been extended to and made applicable in the non-Christian provinces it would appear that the Director of Public Works has no authority to take any action on the matter."

It therefore appears that the power to grant appropriations of public waters is vested only in the Secretary of Commerce and Police for all provinces except those non-Christian provinces not included in the Department of Mindanao and Sulu.

### MAKING APPLICATIONS.

According to the above, therefore, all applications for rights to the use of public waters in the Philippines, with exception of the non-Christian provinces not included in the Department of Mindanao and Sulu, should be made to the Secretary of Commerce and Police through the Director of Public Works. Applications for rights in the non-Christian provinces not in the Department of Mindanao and Sulu should be addressed to the Philippine Commission.

The method of procedure in making applications for water rights and the necessary steps leading up to final action are set forth in sections 14 to 20 of the Irrigation Act. It is not attempted here to explain this law, as it is expected, of course, that all interested persons will read the same for themselves. But it is believed that it will be of interest and benefit to many to deal with the successive steps in their order, calling attention to some common mistakes and wrong inferences that have come to the notice of the writer, and explaining the methods now employed in the water-rights work.

In accordance with section 14 of the Irrigation Act a water application must be made on a form to be furnished by the Director of Public Works without cost to the applicant. In the Director's office a supply of these forms is kept on hand, together with copies of instructions in detail for properly filling them out. The forms are all printed in English, but the instructions are furnished in

English, Spanish, and the principal dialects as needed, so that no mistakes need occur if the applicant does not read English. These forms and instructions are mailed free upon request. A limited number of copies of the Irrigation Act is also kept on hand for distribution to interested parties.

When an application is received, it is examined in order that the Director may ascertain whether it contains all the necessary information. If the application is defective, it is returned to the applicant with explanation relative to the necessary changes.

The most common defects in the applications submitted are indefinite or inaccurate descriptions of the locations of the sites of diversion and of the lands to be irrigated, and inadequate information relative to the irrigable area and the amount of water desired.

The location of the diversion, or point where the water is to be taken from the stream, and the location of the land to be served should be described by means of accurate distances and directions with reference to well-known and permanent points, preferably monuments established by the Bureau of Lands. A convenient way to describe these locations is by means of a map or sketch accompanying and made a part of the application. In some cases it is necessary for the applicant to have a survey made to locate the boundaries of his land and his diversion site. In most cases, however, especially where the land has already been surveyed, it is possible for the applicant to obtain the necessary data without the assistance of a licensed surveyor.

In many cases the amount of water needed is not known and the statements concerning this are not clear. On the average, the amount of water required to irrigate 1 hectare of land is about 1 liter per second. This requirement depends considerably upon the nature of the soil, porous sandy soil needing more than a compact soil such as clay. When the applicant is in doubt as to his soil requirements, he should request too much rather than too little water. When the investigation is made prior to final action on the application, this feature of the matter will then be looked into and reported upon. If the amount requested is more than needed, the application will be cut down; but the writer fails to find any provision in the law for allowing a greater appropriation than the applicant requests.

It is obvious to anyone after reading the Irrigation Act that the matter of accurate description of the location of the diversion site and of the land to be served is of prime importance. In all future work of adjusting claims and distributing water on a stream, the place of diversion must be definitely known in order to identify the claim. Also, the natural flow of the stream may vary considerably within a short distance. In section 40 it is stated that the right to use of water for irrigation purposes shall remain appurtenant to the land for which the said right of use is established. It follows, therefore, that the location of the land for which a water right is granted must be definitely known.

## PUBLICATION OF THE APPLICATION.

After the application is received in the Director's office in correct form, it is given publicity in the manner prescribed in section 15. Notices are prepared in English, Spanish, and the local dialect and forwarded for posting in the municipality affected, where the matter is also brought to the attention of the people by the public criers. The notice of the application is also published once a week for four consecutive weeks in a newspaper having general circulation in the province affected.

Any person who is interested in the proposed appropriation and who wishes to object to the same, is invited to file a written protest in the Director's office, stating the reason for his objection, the time allowed for receiving such protest terminating thirty days after the day of the last publication in the newspaper.

From the manner and amount of the publicity required, it does not seem probable that an interested person would fail to learn of the proposed appropriation. Section 15, however, provides that failure or omission to file a protest shall not work to the detriment of existing rights.

## INVESTIGATION OF THE APPLICATION.

After the expiration of the period allowed for receiving protests, this period being named in the publication, the necessary investigations regarding the proposed appropriation are made. The investigation in the field usually covers the following points:

(1) *Approximate amount of water in the stream at the different stages of flow.*—If there are no records of gauging on the stream, the flow is measured at the time of the investigation by approximate methods, and is estimated for other stages by means of high-water marks, testimony of natives, and by such other means as in the judgment of the investigator are adaptable to the case in hand.

(2) *Nature and amount of present appropriations.*—Usually a general knowledge of the country through which the stream flows, together with the observations that can be made in a reasonable time, will enable the investigator to determine whether the waters are already appropriated to any considerable extent. Also, after the wide publicity given an application, the present appropriators on a stream usually file protests in a case where there appears to be danger of shortage of water, copies of such protests being furnished the investigator. These protests usually help considerably in deciding whether the matter in hand can be settled without an adjudication.

(3) *Testimony of interested parties.*—Sections 8 and 15 of the Irrigation Act provide that any official designated by the Director to make investigations of this sort may examine witnesses under oath and for that purpose is authorized to administer oaths and to take affidavits. In some cases where the statements are conflicting and where the investigator must depend largely upon testimony for necessary information, this means can be employed to advantage. The sworn statements are forwarded with the rest of the report for consideration by the irrigation council.

(4) *Whether the proposed appropriation would be detrimental to the public interest.*—The report of the investigation should show whether the proposed works would be liable to cause flooding and damaging of public or private property, impede navigation, endanger lives, or in any other way be prejudicial to the interests of others. It is a well-known fact that, aside from the relatively small damage which may be caused by an individual structure in a stream, the indiscriminate obstruction of natural water courses is one of the principal causes of damages during floods.

(5) *Nature of the soil to which the water is to be applied.*—Some soils, such as very sandy or gravelly ones, being very pervious to water, require in some cases more than double the amount of water that is needed for the more impervious soils such as gumbo and clay. This point should always be taken into consideration. Usually the lands in a certain locality have similar soils, so that a general knowledge of soil conditions in the different localities should be an assistance in deciding upon this point.

(6) *Other facts which in the judgment of the investigator should be considered before final action on the application is taken.*—Much depends upon the judgment and knowledge of the investigator and it is not attempted to lay down hard and fast rules as to how he shall obtain the necessary information. But, in order to do the work intelligently and economically, he must bear in mind the general scheme of which his work is a part and must know how the information he secures is to be used. He should, therefore, inform himself in this respect by a careful reading of the Irrigation Act.

When it develops during the investigation relative to a water application that the matter is so complicated by protests and conflicting claims, or that the number and amount of present appropriations are so uncertain, that it is not possible to determine in a reasonable time whether there is unappropriated water for the applicant, then the investigation should be discontinued and the facts reported to the Director's office. In such case it has been the practice for the Director to recommend an adjudication of the stream and to suspend action on the application pending the adjustment of the existing claims.

## FINAL ACTION ON THE APPLICATION.

After the necessary investigation has been made, the Director makes his report and recommendation to the Secretary of Commerce and Police relative to the application. At a meeting of the irrigation council, of which the Director and Secretary are members, final action is taken and the original application is returned to the applicant with the approval or disapproval indorsed thereon.

### TIME REQUIRED TO SECURE A WATER RIGHT.

From the foregoing it will be seen that final action on an application should not be expected under about three months under the most favorable conditions, as the minimum time allowed by law for receiving protests alone is sixty days. Owing to necessary revisions of many of the applications received, bad weather conditions affecting investigation work, etc., the time required is usually nearer five or six months. It is, therefore, unwise for the applicant to wait until near the time he wishes to use the water before making his application.

### NUMBER OF APPLICATIONS HANDLED.

The rate at which water applications are being filed in the Bureau of Public Works is rapidly increasing. The total number filed since the passage of the Irrigation Act is 971. Of these, final action has been taken on 204, 390 are held up pending final adjudication of present rights on various streams, 262 have been returned for amendment and have not been refiled, and 115 are now active.

### ADJUDICATION OF WATER RIGHTS.

The method of adjudicating the rights on a stream is set forth in sections 5 to 11 of the Irrigation Act. This is the only way in which the priority rights among conflicting claims can be legally established. It involves publicity notices; receiving statements of claims; examining claimants and witnesses; mapping the stream, the existing works, and the lands irrigated; and measurements of the discharge of the stream and the carrying capacities of the various ditches leading from the stream. The time required for this work on an average stream is perhaps a year, although the work may be done on a number of streams during the same period. Where a case is appealed to the court, however, as provided in section 10, the time until the final adjustment is accomplished will be longer.

In the adjudication of any stream the field work will be greatly simplified if a cadastral survey has been made of the lands affected, for then the survey work required for the map mentioned in section 7 will be reduced to only the determination of the irrigable portion of each holding. It appears that it might be good economy for the Bureaus of Lands and Public Works to make arrangements whereby cadastral surveys of lands soon to be involved in adjudication proceedings would include the additional survey work required in the adjudication.

Nineteen streams have been designated by the Secretary of Commerce and Police, upon the recommendation of the Director, for adjudication. Work is now in progress on all of them and is being carried on as rapidly as is possible with the limited funds allotted for this work.

### NECESSITY AND IMPORTANCE OF ADJUDICATION WORK.

The granting of a water right prior to the complete adjudication of existing rights on a stream might be considered as only an expedient to provide for the beneficial use of waters known to be running to waste, to avoid delay until the adjudication can be made. However, in most cases where there are already many appropriators on a stream, it is either very difficult or is impossible to ascertain whether all the water is being beneficially used during the irrigation season, except by adjudication.

Numerous complaints arising from conflicting claims are constantly being received in the Director's office. These are investigated and the difficulties are remedied when possible; but in the majority of cases no definite settlement of such matters can be had until an adjudication is made of the waters in dispute.

After a careful reading of the Irrigation Act, the importance of the adjudication of water rights on the various streams in the Philippines cannot but appeal to any person interested in the country's development. It will be seen that this work is a necessary preliminary to the construction of irrigation projects both large and small. One of the first and most important matters to be considered before the construction of an irrigation project is, of course, the water supply. All existing rights on the stream to be diverted must be known, as well as the amount of water in the stream during the different seasons of the year. The adjudication of claims on a stream, in accordance with section 7 of the Irrigation Act, includes the measurements of the discharge of the stream. The work of stream gauging was discontinued in November of 1913. Provision will probably be made for continuing this work next year, and also for increasing and expediting the adjudication work in general.

Almost everybody seems to realize the necessity of cadastral surveys for the purpose of establishing boundaries and titles of lands. It is realized that the rapid development of the country depends largely upon the degree of assurance property holders may have that their permanent improvements will not be lost on account of defective titles. To no less extent will the permanent adjustment of claims to water rights promote permanent development. In many places the established titles to waters in a public stream are just as valuable as the lands that are served. It is no more unreasonable to build costly structures on lands to which titles are doubtful than to construct costly works for the diversion and distribution of unadjudicated waters.

## LAWS GOVERNING WATERS IN THE PHILIPPINE ISLANDS.

By E. GARCIA, Law Clerk, Bureau of Public Works.

Under the Laws of the Indias (Vol. II, Law 36, and Vol. IV, chap. 12, Laws II, III, V, VI, VII, VIII, X, XI, and XIV; Ultramarine Legislation, by Rodriguez San Pedro, Vol. IV, from p. 666; Guide, by Rodriguez Berriz, from p. 2) lands and waters were granted gratuitously to the original inhabitants of the Philippine Islands by the Spanish Government in the early days. It was recognized from the very beginning that water for the irrigation of the lands granted is necessary. Nevertheless, no separate laws relative to the disposition and appropriation of public waters in the Philippine Islands were enacted until September, 1871. The causes of the delay were perhaps due to the facts that the country was new and thinly populated; that there was sufficient water for the needs of all who desired to make appropriations; and that there was no occasion for conflicts of rights to the use of public water to arise. Thus, the tillers of the soil were left to themselves and allowed to appropriate as much water as they pleased and in their own way. But as the country grew, and civilization advanced, the necessities of the people demanded that specific legislation relating to this important branch of the public wealth be enacted. In this connection it should be stated that until September 24, 1871, there was no law especially applicable to the Philippine Islands. The promulgation in the Philippines of the Law of Waters of August 3, 1866, was made on September 24, 1871. Before this date all questions concerning public waters were disposed of in accordance with the provisions of the Partidas. (Ker & Co. *vs.* Cauden, VI Phil. Rep., p. 732.)

On August 8, 1866, the home government requested the superior civil governor of the Philippine Islands to draft a proposed bill for legislative enactment regulating the use and disposition of public waters. (Letter to the superior civil governor of the Philippine Island of August 8, 1866.) On September 24, 1871, the Spanish Law of Waters of August 3, 1866, was published in the Gaceta de Manila and made applicable to these Islands. (Ker & Co. *vs.* Cauden, VI Phil. Rep., p. 735; Samson *vs.* Dionisio, XI Phil. Rep., p. 541.) This has since been the law of waters in the Philippines until August 13, 1898, when it was modified by the change of sovereignty. As a supplement to its provisions, articles 339, 344, 366–374, 407–425, 552–563, and 586–588 of the Civil Code were promulgated on December 8, 1889.

The Supreme Court of the Philippine Islands, in the case of Ker & Co. *vs.* Cauden, held that the laws above cited are still in force as modified by subsequent legislation. Laws passed by the Philippine Commission and the Legislature affecting the Law of Waters are as follows: Act No. 667, section 12, providing that "neither the provincial board nor the council of any municipality shall have power to confer the right to use water power derived from any of the streams in the province or municipality in connection with the franchise, the granting of which is herein provided for. Water-power rights are hereby declared to be grantable only by and in accordance with Acts of the Commission;" Act No. 926, sections 74, 75, and 76, providing

that the Director of Lands shall have power to grant rights to use any flow of water in any stream, the convertible power from which does not exceed 50 horsepower; Act No. 1120, section 19, providing that public waters within the friar lands shall be administered under the direction of the Director of Lands for the common benefit of those interests dependent upon them; Act No. 1854 authorizing the Secretary of Commerce and Police to establish and maintain irrigation systems throughout the Islands; and Act No. 2152, the "Irrigation Act," providing for the adjudication of claims to existing water rights, for the granting of new water rights, and for the construction of irrigation systems throughout the Philippine Islands, except in such portions over which the Philippine Commission exercises exclusive jurisdiction. In this connection it should be noted that by Executive Order No. 71, series 1914, the provisions of Act No. 2152 were, impliedly, made applicable to the Provinces of Agusan and Bukidnon and by Executive Order No. 3, dated January 20, 1915, the provisions of the same Act were similarly made applicable to the Provinces of Cotabato, Davao, Lanao, Sulu, and Zamboanga, Department of Mindanao and Sulu. The Act does not apply to the non-Christian provinces of Luzon. It should also be noted that by a special Act of the Commission the Governor-General was empowered to grant to the authorities of the United States Army in the Philippine Islands the privilege of using the current of the Bued River in the Mountain Province for the purpose of operating an hydroelectric plant and a pumping station (Act No. 2273).

Act No. 2152 is the latest law on the subject of waters. It repeals all laws, Acts, or parts of Acts inconsistent with its provisions, in the matter of waters; and other existing laws dealing with waters and irrigation systems in so far as they are not incompatible with its provisions shall continue in force.

Now the question arises: What provisions of the existing Ley de Aguas and the Civil Code in the matter of waters and laws dealing with waters and irrigation systems are compatible with the provisions of Act No. 2152? The answer is as follows:

1. THE SPANISH LAW OF WATERS OF AUGUST 3, 1886.

*Article 1.*—In force. The change of sovereignty has substituted the word "Philippine" for the word "Spanish."

*Articles 2–4.*—In force. (Ker & Co. *vs.* Cauden, 6 Phil., 732, affirmed by U. S. Supreme Court on February 19, 1912; Sugar *vs.* Insular Government, 18 Phil., 378.)

*Article 5.*—In force. "We may affirm that the title to the ownership of the sea and its shores does not reside in the Insular Government, but in the national society, for which reason the Government may not alienate the seashores while they are such shores, nor the sea while it is sea. The Government may, nevertheless, cause the public use thereof to cease—that is, the use by private persons as members of the body politic—and devote the sea and its shores to the public uses of the state. Out of this arises the right of the Government to fill in the shores and sea and to acquire ownership of the land thus formed. In such a case the sea and its shore ceases to be such, and the use thereof by the public having ceased, said land reverts to the ownership of the state." (3 Op. Atty. Gen., p. 130.) For further reference see Act No. 1654 and Aldecoa & Co. *vs.* Insular Government (9 Off. Gaz., p. 37).

*Article 6.*—Modified. The Insular Collector of Customs is empowered to dispose of goods cast by the waves upon the coast.

*Articles 7–11.*—In force. For further reference see section 1375 et. seq., Compilation.

*Article 12.*—In force. It is, however, subject to the customs laws and regulations.

*Article 13.*—In force.

*Article 14.*—The first sentence is in force. The second is modified by the change of sovereignty. The right belonging exclusively to Spanish registered seamen or merchant sailors now belongs to the public. The privilege to fish from the shore and within the marine zone is being regulated by sec. 43 (*c*) of the Municipal Code (4 Op. Atty. Gen., 107; 2 Op. Atty. Gen., 190; Op. Atty. Gen., Aug. 22, 1910, unp., modifying 2 Op. Atty. Gen., 102; Op. Atty. Gen., Nov. 2, 1901, unp.; 2 Op. Atty. Gen., 335; 4 Op. Atty. Gen., 360, concurred in by Ex. Sec. and Ins. Aud. in Prov. Div. Cir. 123; also by Ex. Sec. in Op., Sept. 7, 1909; 2 Op. Atty. Gen., 590; Op. Ex. Sec., Feb. 13, 1909; Op. Atty. Gen., Apr. 24, 1909, unp.; 4 Op. Atty. Gen., 168; 2 Op. Atty. Gen., 93; Op. Atty. Gen., Sept. 24, 1907, unp.; Act No. 1634; Act No. 1499 as amended by Act No. 1685; U. S. *vs.* Gregorio, Court of First Instance, Pangasinan, Nov. 19, 1908; Mapa *vs.* Insular Government, 10 Phil., 175; Diokno *vs.* Reyes et al., Court of First Instance, Batangas, Jan. 3, 1907; Cordero *vs.* Prov. Board of Batangas et al., Court of First Instance, Batangas, Dec. 29, 1906.)

*Article 15.*—In force.

*Article 16.*—The first part is in force; the rest, "subject in regard to the extraction of salt to the special laws of the Treasury Department," is repealed.

*Article 17.*—In force. The right is regulated by section 39 (*jj*) of the Municipal Code. (3 Op. Atty. Gen., 262.)

*Articles 18–24.*—In force. The permission referred to may be granted by the municipal council under section 39 (*j*) of the Municipal Code. (2 Op. Atty. Gen., 406; see also Act No. 1654; Montano *vs.* Insular Government, 12 Phil., 572.)

*Article 25.*—Repealed. Procedure must be in accordance with that provided for by the municipal council.

*Article 26.*—That part of the first paragraph, "The Government may alienate marshy lands" is in force. But marshy lands "forming a part of the communal property of the pueblos" are governed in their disposition by the provisions of the Municipal Code. The rest of the first paragraph is repealed.

The first part of the second paragraph is in force. The permission referred to is obtainable not from the governor, but from the municipal council. The rest is repealed.

*Article 27.*—Omitting the phrase "After consulting the consejo de estado (state council)," the rest of the article is in force.

*Article 28.*—In force. But the concessions are subject to the provisions of Act No. 2152.

*Article 29.*—Substitute "municipal council" for "governor" and omit the phrase "after consultation with the naval authorities and provincial chief of the engineers of roads." With this modification the article is in force.

*Article 30.*—In force. "Aguas fluviales" was incorrectly translated. The correct translation is "rain water."

*Article 31.*—In force.

*Article 32.*—Omitting the phrase "after reporting to the governor," the first paragraph is in force. The second paragraph is repealed. The interested party may appeal to the provincial board.

*Article 33.*—In force.

*Articles 34–36.*—These articles refer to the contingent use of private waters. Contingent use is a peculiar kind of right granted by the Law of Waters. They are in force in so far as they relate to contingent use of private waters.

*Article 37.*—Repealed. Contrary to provisions of Act No. 2152.

*Article 38.*—In force. (Op. Atty. Gen., Oct. 15, 1908, unp.)

*Article 39.*—Period of prescription is now ten years. (Code of Civil Procedure, chapter on prescription.)

*Articles 40–42.*—In force in so far as they relate to the contingent use of private waters.

*Article 43.*—Modified. Medicinal waters may be acquired by the Government by condemnation proceedings.

*Article 44.*—In force.

*Articles 45–65.*—In force. Not incompatible with the provisions of Act No. 2152.

*Articles 66–110.*—In force. The permission referred to in these articles may be obtained from the municipal council.

*Article 111.*—In force. (Lunod *vs.* Meneses, 11 Phil., 128; decision of the Supreme Court of Spain, Apr. 22, 1892.)

*Articles 112–141.*—In force. Substitute the words "Court of First Instance" for the word "governor" in article 119, the words "municipal council" for the word "alcalde" in article 124, the phrase "Court of First Instance" for "provincial council" and "governor" in article 126. Change twenty years to ten years in paragraph 3, article 140. (Code of Civil Procedure, chapter on prescription.)

*Article 142.*—In force. The easement provided for in this article can only be acquired for the purpose enumerated in article 118.

Article 554 of the Civil Code refers to the same kind of easement and article 563 further provides that everything relative to the establishment, extension, form, and conditions regarding waters not provided for in the Civil Code must be governed by the "Law of Waters." (4 Manresa, 696–697.)

*Articles 143–146.*—In force. Substitute "Court of First Instance" for "governor of province" in article 143, for "alcalde" and "municipal council" in article 146, and the appeal referred to in said article 146 should be taken to the Supreme Court. (Sec. 18 of Act No. 136.)

*Articles 147–151.*—In force. The purpose of this easement is to favor rural population. Substitute "Court of First Instance" for "governor of province" in article 151.

*Articles 152–165.*—In force. Substitute "Court of First Instance" for "governor of province" in article 161. In the case of Roxas *vs.* City of Manila (9 Phil., 315), the Supreme Court said:

"If the stream in question is a canal, though a navigable one, and held so to be by competent authority * * * and it is desired to establish a tow path * * * it must be remembered that the law does not grant it along a navigable canal, and at all events the establishment thereof must be preceded by the corresponding indemnity."

*Articles 166–168.*—In force. These articles are not incompatible with the provisions of Act No. 2152.

*Articles 169–174.*—In force. The exercise of the right to fish, however, is regulated by section 43 (*c*) of the Municipal Code. With reference to the permission mentioned in article 172, the governor of the province has no authority to grant said permission.

*Article 175.*—This article is in force in so far as it relates to the power of the Government to declare what rivers are to be regarded as navigable, either in whole or in part. There is no official, however, in the Philippine Islands to-day authorized to determine the question of navigability of rivers. A law on this subject is, therefore, very desirable.

*Articles 176–191.*—Modified by the Act of Congress of April 30, 1906, and Laws and Regulations of the Bureau of Customs and Bureau of Public Works.

*Articles 192–208.*—Superseded by provisions of Act No. 2152 as regards new appropriations of public waters. The power to grant appropriations of public waters is now vested in the Secretary of Commerce and Police, subject to the approval of the irrigation council in accordance with the provisions of Act No. 2152.

*Articles 209–210.*—In force. Subject is not covered by Act No. 2152.

*Articles 211–219.*—Repealed by section 40 (*g*) of the Municipal Code which provides that the "municipal council is empowered to construct waterworks for the purpose of supplying the inhabitants of the town with water, and control the use of said water and of watercourses within the town." A municipality can supply the town with water from artesian wells or rivers, and in the latter case its right to appropriate the water is subject to the provisions of Act No. 2152.

*Articles 220–252.*—Repealed. Subject is covered by provisions of Act No. 2152.

*Articles 253–258.*—In force. There is no provision relating to navigation canals in Act No. 2152. Substitute "Philippine Legislature" for "Cortes" in article 255.

*Articles 259–265.*—In force. The power to grant the permission referred to in these articles is now vested in the municipal council. The municipal council is empowered to regulate the use of the water within the municipality.

*Articles 266–267.*—Repealed by the provisions of Act No. 2152.

*Article 268.*—In force. Substitute "municipal council" for "governor." The municipal council, by section 39 (*j*), is empowered to declare and abate nuisances.

*Articles 269–270.*—Repealed by the provisions of Act No. 2152.

*Articles 271–274.*—Repealed. Provincial governor cannot perform the administrative functions conferred by Spanish laws unless they have been authorized to that effect by American laws. Consequently the present provincial governments cannot exercise the powers conferred by the Law of Waters upon the governors of provinces. (2 Op. Atty. Gen., 405; 4 Op. Atty. Gen., 702.)



*Article 275.*—In force. This article, giving the local authorities police jurisdiction over waters, is in accord with the present laws. Section 39 of the Municipal Code confers upon the council the police power over waters within the boundary limits of the municipality.

*Article 276.*—"The police of wharves on rivers and lakes, and in ports, shall be within the province of the local civil authorities." This part of the article is in force and the rest is repealed.

*Article 277.*—Repealed. Appeals in administrative cases of this nature may be taken to the provincial board or a civil action may be brought in court by the aggrieved party.

*Article 278.*—Repealed. This is repugnant to the laws now in force in these Islands. Any Government official at the present time may, upon proper showing, be required to refrain from a particular act.

*Articles 279–295.*—Repealed. The subject matter in these articles is completely covered by the provisions of Act No. 2152.

*Articles 296–300.*—In force. Consistent with the provisions of Act No. 2152.

### II. THE SPANISH CIVIL CODE.

*Article 339.*—In force.

*Article 344.*—In force.

*Article 374.*—In force.

*Articles 407–408.*—In force. They are not affected by sections 19 and 50 of the Act of Congress of July 1, 1902. (1 Off. Gaz., 48.)

*Article 409.*—This is in force except as to the prescription. Water being by the terms of article 334 (8) real estate, the prescription of ten years stated in section 41 of the Code of Civil Procedure is now applicable.

*Article 410.*—In force. Section 51, Act of July 1, 1902. (1 Off. Gaz., 48.)

*Article 411.*—In force. The right, however, might be lost in ten years by prescription. (Sec. 40, Code of Civil Procedure.)

*Article 412.*—In force, except as to the last sentence.

*Articles 413–422.*—In force.

*Article 423.*—In force, but the laws referred to are now sections 241–253, Code of Civil Procedure. Acts 294 and 665 of the Commission and Act of Congress of July 1, 1902. (1 Off. Gaz., 48.)

*Articles 424–425.*—In force.

*Article 552.*—In force.

*Articles 553–554.*—In force. If the parties do not agree upon the compensation to be paid, it must be determined by an ordinary action in the Court of First Instance. The provisions of the Law of Waters of 1866 cannot now be enforced by the present administrative officers.

*Article 555.*—The power of eminent domain can be exercised by a municipality, but not by a number of persons not less than ten living together. Such a group of people must exercise the right given them by this section through an ordinary action in the Court of First Instance.

*Articles 556–558.*—In force, except No. 3 of article 558. The indemnity must now be determined by an ordinary action in the Court of First Instance.

*Articles 559–562.*—In force.

*Article 563.*—Repealed.

*Articles 586–587.*—In force.

*Article 588.*—In force. The indemnity, if the parties do not agree, must be determined by an ordinary action in the Court of First Instance.

Comments upon the Spanish Civil Code are based upon "Willard's Notes to the Spanish Civil Code."

### III. THE ACTS OF THE PHILIPPINE COMMISSION AND PHILIPPINE LEGISLATURE.

*Act No. 667, section 12.*—In force.

*Act No. 926, sections 74, 75, and 76.*—The authority of the Director of Lands to grant water-power privileges not exceeding 50 horsepower was impliedly revoked by Act No. 2152, except over portions of the Archipelago under the exclusive control of the Commission.

*Act No. 1120, section 19.*—In force as to the friar lands.

*Act No. 1854.*—Repealed by Act No. 2152.

*Act No. 2152.*—In force.

From the foregoing it will be observed that the only important laws relating to the appropriation and disposition of public waters in the Philippine Islands to-day are the Spanish Law of Waters and the Civil Code as above annotated, and Act No. 2152, the Irrigation Act. Act No. 2152 is the most important of the three, because it provides for the *adjudication of existing old water rights* by administrative officials, for the *granting of new water rights* to all who shall make beneficial use of public waters, and for the *construction of irrigation systems* by the Government. Under the provisions of this new law the Secretary of Commerce and Police, through the Director of Public Works, is now in charge of this work. He is the only official in the Government of the Philippine Islands authorized to grant appropriations of public waters and to settle controversies between persons claiming rights to the use of the same in accordance with the provisions of Act No. 2152.

The provisions in this law relating to the adjudication of existing water rights are designed to provide for an orderly distribution of the appropriated waters of natural streams. Were there no provisions for ascertaining and fixing the relative rights of each appropriator, confusion in the division of water for irrigation purposes would most likely result; each appropriator, regardless of the rights of others, might seek to take an undue amount of water through his diverting works; and suits between individual appropriators would be numerous and never-ending. The purpose of adjudication is to settle questions as to the relative priorities of the claimants of water from a natural stream for the purposes of irrigation, to the end that the public records may preserve an accurate and well-defined statement thereof, and as an aid to adequate and effective Government control of public waters.

The provisions relative to the granting of new water rights are designed to bring under cultivation the immense tracts of virgin soil lying idle and uncultivated throughout the Philippine Islands. They are for the purpose of making agriculture independent of the caprice of weather conditions and assuring regular and abundant harvests.

The provisions relating to the construction of irrigation systems are designed to promote irrigation on a large scale and to help communities which are unable to construct irrigation systems on their own account. In fine, the Irrigation Act, making possible the construction of irrigation systems by the Government, is an expression in concrete form of that fundamental principle that good governments are established for the interests of the governed.

### SUMMARY.

It will be noted from the above that prior to the promulgation of the Law of Waters on September 24, 1871, questions concerning waters were governed by the Laws of the Partidas. From September 24, 1871, to August 13, 1898, concessions of public waters exceeding 100 liters per second were granted by the Central Government (sec. 234, Law of Waters); less than 100 liters per second, by the governor of the province (sec. 235, Law of Waters); not exceeding 10 liters per second by the alcalde of the pueblo (sec. 37, Law of Waters). From August 13, 1898, to July 26, 1904, the date on which Act No. 926 was approved by the President of the United States, concessions of public waters were granted by the Philippine Commission by means of special Acts; from July 26, 1904, to February 6, 1912, the date on which Act No. 2152 was passed by the Philippine Legislature, concessions of public waters, the convertible power from which exceeded 50 horsepower, were granted by the Commission or the Philippine Legislature; and concessions not exceeding 50 horsepower, by the Director of Lands (Act No. 926, secs. 74, 75, and 76). From February 6, 1912, to the present time concessions of public waters were granted by the Secretary of Commerce and Police through the Director of Public Works.

It will also be noted that a right to use public waters in the Philippine Islands was acquired during the Spanish régime by prescription of twenty years—that is, twenty years' continuous use of public waters. A person who has enjoyed the use of public waters for irrigation or power by means of dams, waterwheels, or any other important and permanent structure for a term of twenty or more years without objection on the part of the authorities or any third person, is entitled to continue its enjoyment. But by the passage of Act No. 190 (Code of Civil Procedure) on October 1, 1901, the period of prescription with reference to waters was changed from twenty to ten years.

## A SUGGESTED FORM FOR A MUNICIPAL WATER ORDINANCE.

By C. E. Gordon, Chief Designing Engineer.

On completion of the municipal water supply systems which the Bureau has constructed in recent years, the central office has in each case been asked to frame a water ordinance for the administration of the system. The recommendations offered to these municipalities have been framed along the same general lines, but have been modified to suit particular requirements. As the fundamental principles underlying waterworks administration in all communities are very much the same, the following general ordinance has been written to assist municipalities in the framing of their own. As indicated by the title, this ordinance is only suggestive and it is expected that it will be modified to suit the requirements of individual cases.

### RULES AND REGULATIONS.

It is hereby ordained by the municipal council of....., that the following rules and regulations shall be a part of the contract with every person who takes water supplied by the municipality of....., from the.....water system.

(1) *Supervision of the system.*—After the completion of the water system, as soon as practicable, the municipal council will elect a superintendent who shall have general supervision of the water system and the property and appliances used in connection therewith, and who shall be in responsible charge of the operation and maintenance of the entire system.

(2) *Application.*—No water shall be piped into any premises until application for the same has been officially approved. The application shall be made to the superintendent of the water system on a prescribed form. It shall explain in full all uses to which the water is to be applied and shall describe the exact location of the premises to be served.

(3) *Uses of water not named on application.*—The use of water for purposes not mentioned in the application shall be considered a violation of the consumer's agreement with the municipality. Whenever it is ascertained that the consumer is violating this agreement, his water service will be discontinued until the application is renewed and made satisfactory to the superintendent.

(4) *Contract with municipality.*—The approved application shall be filed in the office of the superintendent of the water system and shall thereafter be considered a contract between the consumer and the municipality. This contract shall be in force for not less than one year. If the services are discontinued before the end of one year, a charge of ₱.....will be made for shutting off the connection.

(5) *Service connections and fixtures.*—The work of tapping the main, connecting the service pipe thereto, laying the pipe from the main to the property line, including the furnishing of necessary pipe, service cock, meter, and other materials and appurtenances, and including the digging and backfilling of trench, on streets in which a water main is located, will be performed by the employees of the water-supply office and at the expense of the municipality. The cost of all labor and of all materials, except the meter, required inside the property of the consumer shall be borne by the consumer. The meter shall be owned and installed by the municipality, but rent therefor shall be paid by the consumer as stipulated in section 21 hereinafter.

(6) *Plumbers to be licensed.*—All work in connection with interior pipe, fixtures, etc., shall be performed by a competent plumber holding a license granted by the Bureau of Health and under the supervision of the superintendent of the water system.

(7) *Each house to have separate service.*—Each connection or service shall be limited to one house, except where two or more adjacent houses are owned by the same person and the owner desires that all these houses be supplied through one connection.

(8) *Alterations.*—No alteration of any pipes or fixture shall be made without first submitting an application upon the prescribed form to the superintendent and receiving his official approval.

(9) *Prevention of waste.*—Consumers shall prevent any unnecessary waste of water and will be required to keep their faucets, valves, and fixtures in good condition at their own expense. Water will not be supplied to any system known to contain leaky or defective fixtures, and the service will be immediately discontinued when such conditions are discovered.

(10) *Accidents due to direct connection.*—The installation of

pumps, steam boilers, cooling apparatus, or any heating device intended to take water directly from the water supply mains is prohibited. All persons or corporations having such appliances on their premises are hereby cautioned against the danger of accident and, in order to minimize liability of accident from such causes, are hereby directed to provide tanks to maintain a sufficient supply of water for not less than twenty-four hours. The municipality will not be responsible in any way for damage occuring on account of failure of the water user to comply with this provision.

(11) *Meters.*—All water furnished, except as otherwise specified herein, shall be measured through meters which shall be the property of the municipality. All water meters connected with the water-works system shall be under the control of the superintendent, and repairs of meters shall be made only by him. Whenever meters are damaged through the fault or negligence of the consumer, the cost of the necessary repairs shall be paid by the consumer and shall be collected at the same time and in the same manner as the water rates.

(12) *Employees may enter premises.*—The superintendent of the water system or his representatives shall have access at all times to the properties of consumers for the purpose of inspecting meters, connections, etc., or for ascertaining the fulfillment of these regulations.

(13) *Meter reading.*—At least once a month the meters shall be read by the superintendent or his representatives. This reading shall be made in the presence of the consumer or his agents, should he so desire. In case it is suspected that a meter does not register correctly, the case shall be immediately reported to the superintendent for investigation. Should the meter prove upon investigation to register incorrectly, then the amount of water for which collection for the month shall be made shall be the average of the amounts consumed during the three previous months of similar service, or of such portion of three months as the service shall have been in operation.

(14) *Uses of fire hydrants.*—Fire hydrants shall be used for fire purposes only, except such hydrants as shall be designated by the water-supply office to furnish an additional supply for sprinkling purposes. No person or persons other than those employed by the water-supply office or those having authority shall open any fire hydrant or attempt to draw water from the same, or in any manner injure or molest any of the said hydrants.

(15) *Taking water from service hydrants.*—Water shall be taken from public hydrants in open-top vessels. It shall be illegal to take water from these hydrants through a hose, pipe, or through a piece of bamboo, or to convey water from said hydrants in any other manner than that prescribed.

(16) *Water may be shut off.*—The municipality reserves the right to shut off the water supply when the public interests require such action. This measure will be resorted to only under strict necessity and no action shall lie against the municipality for such stoppage. Whenever practicable, the superintendent will notify consumers before shutting off the supply and will state the hour when the supply will be shut off and when it will be turned on again. In case the water is shut off for more than twenty-four hours, a proper allowance shall be made on the minimum charge as stated in paragraph No. 20. No reduction shall be made for stoppage of service for twenty-four hours or less.

(17) *Time of payments.*—Payments for water supplies and services in connection therewith shall be made quarterly to the municipal treasurer, between the 1st and the 20th day of the month following the end of the quarter.

Payments will be made for the quarters ending March 31, June 30, September 30, and December 31.

(18) *Failure to pay.*—Failure to pay the amount due before the 20th day following the quarter in which water was furnished or services rendered will cause the consumer to incur the penalty prescribed hereinafter.

(19) *Owner of property responsible for payment.*—The property owner shall be responsible for the payments for all water used on his property until such time as he shall notify the superintendent in writing to disconnect the water service which pertains to his property. Delinquent payments under the provision of this ordinance shall constitute a lien upon the consumer's property.

(20) *Rates for house service.*—The price of water furnished through meters shall be as follows:

For the first 500 cubic meters per quarter, per cubic meter..... ₱.....
For the next 1,000 cubic meters per quarter, per cubic meter..... .....
For the next 2,000 cubic meters per quarter, per cubic meter..... .....
All above 3,500 cubic meters per quarter, per cubic meter..... .....

except as hereinafter specified: *Provided,* That the minimum charge for any quarter shall be not less than ——— pesos (₱———).

(21) *Rent of meters.*—The following amounts will be collected at the same time and in the same manner as the water payments, for rental of water meters furnished by the municipality.

½ inch or less in diameter, per quarter..... ₱.....
1 inch in diameter, per quarter..... .....

(22) *Rates to houses without service connections.*—All houses having no service connections with the water system, which are located within 100 meters from a street having a pipe line, shall be taxed at the following rates, prior to their connection with the water system. After they are connected to the water supply, and payment is being made therefor at the scheduled rates, these charges shall no longer be made.

Houses valued at—₱250 or less, per quarter..... ₱.....
Over ₱250 to ₱500, per quarter..... .....
Over ₱500 to ₱1,000, per quarter..... .....
Over ₱1,000 to ₱2,000, per quarter..... .....
Over ₱2,000 to ₱3,000, per quarter..... .....
Over ₱3,000, per quarter..... .....

(23) *Rates to steamers, etc.*—Water supplied to tanks, launches, water boats, or steamers, when taken from any public or private hydrant, pipe, or faucet, shall be paid for at the rate of ..... centavos (₱.....) per cubic meter. The work incident to this supply shall be done under the supervision of the superintendent of the water system.

(24) *Rates for public-service hydrants.*—All public hydrants for the free use of the people shall be metered and the same charges as named in paragraphs 20 and 21 will be paid into the waterworks fund by the municipality.

(25) *Rates for fire hydrants and fountains.*—The municipality will pay into the funds of the water system for all fire hydrants and fountains for the use of the municipality, at the following rates:

For each fire hydrant, per annum..... ₱.....
For each fountain, per annum..... .....

(26) *Rates for fire hydrants on private property.*—Fire plugs or hydrants situated on private property in warehouses, factories, etc., shall be installed by the consumer under the supervision of the superintendent after the necessary permit has been secured, and will be charged for at the rate of ..... pesos (₱.....) per quarter for each hydrant. Each such fire plug will be sealed by the employees of the municipality when installed and water therefrom shall not be used except in case of fire. No charge will be made for water used from these fire plugs in case of fire.

(27) *Officials to pay at regular rates.*—All municipal, provincial, and Insular Government officials shall pay for their water services at the regular rates as above prescribed.

(28) *Destruction of property or pollution of water.*—Destroying or injuring any part of the waterworks property or the pollution of the public water supply in any manner will be considered a gross violation of these regulations. Bathing in public fountains or reservoirs is prohibited.

(29) *Breaking seals on meters.*—No person other than an employee of the water-supply office shall break the seal on any meter, public hydrant, fountain, or fire hydrant except in case of fire, and no consumer shall permit said seal to be broken on any meter or hydrant supplied to him except in case of fire.

(30) *Taking water without authority.*—No person shall open or cause to be opened without proper authority any connection that has been shut off by the officials of the water system, or to take water from the system in any other unauthorized manner.

(31) *Excavating near pipe lines.*—No person will be allowed to make excavation for any purpose in any street or road on which a pipe line of the water system is installed, or to excavate over a municipal pipe line wherever laid, without first making written application to, and obtaining written permission from the superintendent of the water system. Said application must state clearly for what purpose the excavation is to be made.

(32) *Violations with respect to municipal property.*—Any or all persons violating any part of these rules and regulations appertaining to the municipal waterworks property shall be fined from ₱10 to ₱500 Philippine currency for each and every offense, or imprisoned from one to one hundred days, or both fined and imprisoned at once at the discretion of the court.

(33) *Violations with respect to house service.*—In case of violation of these rules and regulations with respect to house services, the water-supply office will shut off the water until the matter is satisfactorily settled, and a fee of ..... pesos (₱.....) Philippine currency is paid for reopening the service.

(34) *Delinquent payments.*—In case the amount due from a consumer for water furnished or services rendered is not paid within the time specified, the water supply will be shut off and will not be again turned on until the amount due, plus a charge of..... pesos (₱.....) for reopening the service has been paid to the municipal treasurer.

(35) *Police shall enforce.*—It shall be the duty of the municipal police and of all persons employed by the municipality who have police authority to enforce the provisions of this ordinance and to arrest all persons infringing thereon.

(36) *Further rules and regulations.*—The municipal council reserves the right to make such further rules and regulations as may be necessary for the preservation and protection of the water system.

(37) *Ordinance effective on passage.*—This ordinance shall be effective on and after the date of its passage.

## SINGSON WATERWORKS AT VIGAN, ILOCOS SUR.

By J. H. AYRES, Associate Member, American Society of Civil Engineers.

[See title-page for concrete standpipe, Mira Hill, Vigan, Ilocos Sur.]

During March, 1912, investigations were started by this Bureau for the purpose of providing Vigan with an adequate water supply. The first project that was considered proposed the utilization of the Naguid–Dayan Springs, situated 7 kilometers east of Vigan, as the source of supply. As these springs are approximately at the same elevation as Vigan, a pumping plant would have been necessary, which, if adopted, would have caused high initial and maintenance costs. During the investigation of the variation of flow of the Naguid–Dayan Springs, information was offered by the inhabitants that there existed another spring with a constant flow at a much higher elevation. This spring is called the Canyau Spring and is located in the barrio of Piang about 9.5 kilometers from Vigan. After a large number of weir gaugings, extending throughout the dry season, had been made, it was evident that the Canyau Spring would furnish, with a small storage, a gravity supply of sufficient quantity for supplying the domestic and fire-operation needs of Vigan. The Naguid–Dayan project, with its expensive pumping units, was therefore abandoned, and plans and specifications were drawn up by the designing division for a system with the Canyau Spring as the source. The cost of the project was estimated at ₱115,000.

The following appropriations were provided:

| | | |
|---|---|---|
| Funds from the municipality of Vigan: | | |
| Insular loan | | ₱40,000.00 |
| Insular aid funds: | | |
| Act No. 2378 | ₱65,000.00 | |
| Act No. 2494 | 15,000.00 | |
| | | 80,000.00 |
| Total | | 120,000.00 |

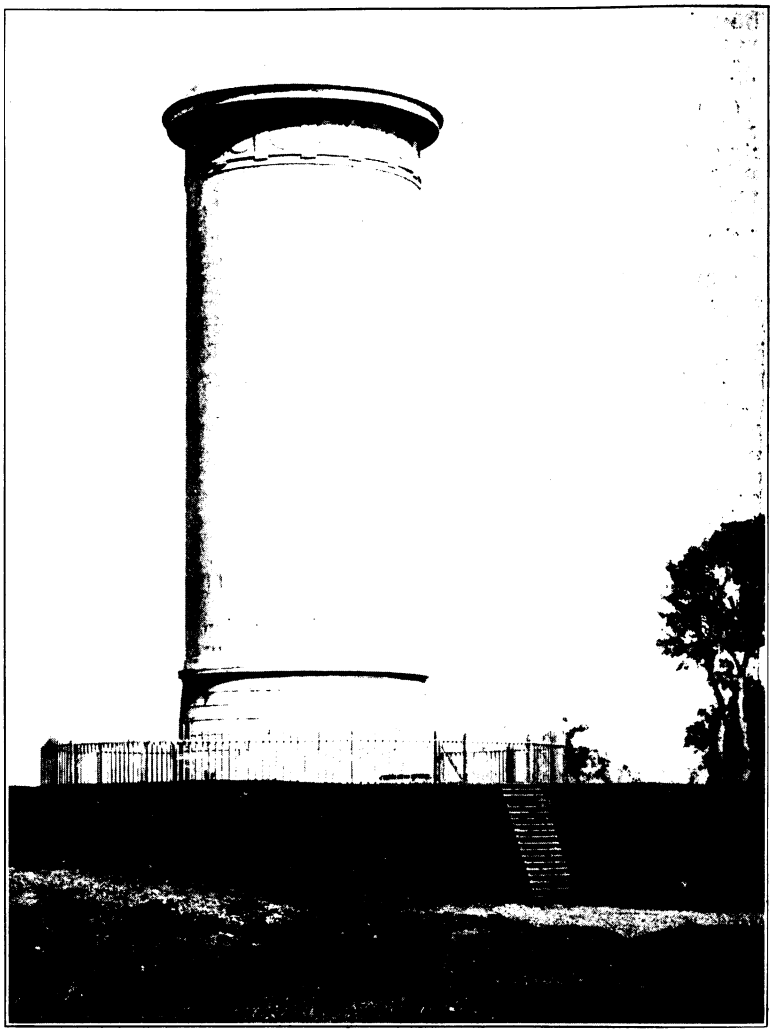
The proposed work was advertised, and on September 30, 1914, proposals were opened. Germann & Co., of Manila, was awarded the contract for furnishing the steel pipe, and the Frank L. Strong Machinery Company, of Manila, the contract for furnishing the cast-iron pipe. Only one proposal was submitted for the construction of the system and this was rejected on account of the excessive prices named. The Bureau decided to build the entire system by administration, and the writer was detailed as acting senior supervising engineer in charge of construction.

The Singson Waterworks, as constructed, embraces a small headworks in the mountains; 10.8 kilometers of steel supply main; a cast-iron distribution system in Vigan; and a 200,000-gallon concrete storage tank on Mira Hill, which is located in the suburbs of Vigan. These will be described in order.

### THE HEADWORKS.

The source of supply consists of two springs having a combined minimum flow of 200,000 United States gallons in twenty-four hours. In the report of the analysis of the water of the springs by the Bureau of Science, the following statement is made: "Judged from a chemical standpoint, the results obtained show that at the present time this spring water is satisfactory for drinking and domestic purposes. However, attention is invited to the fact that a supply such as this might become polluted during rainy weather or by human or animal agencies." The watershed which might affect the springs is of a very rugged nature and small in area, making it very undesirable for human habitation and unfit for grazing purposes. This area has been surveyed and is now being registered as a Government reservation. With a patrol at the springs, the possibility of contamination will be practically eliminated.

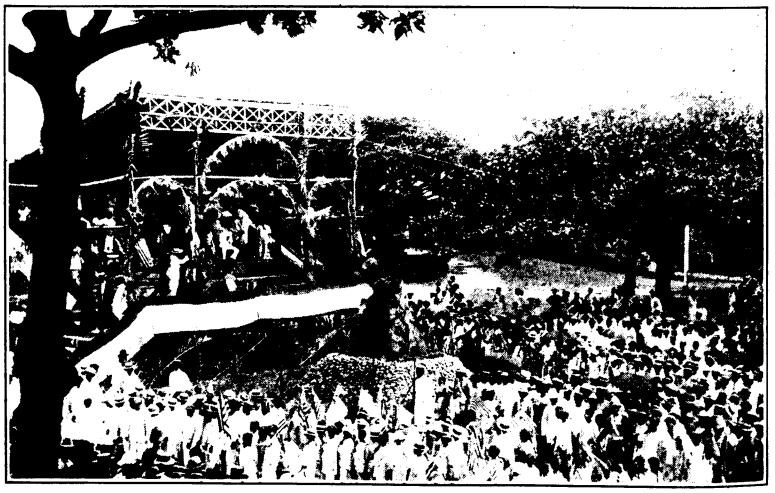
A short distance below the confluence of the two springs, a small weir has been constructed, 2 meters in height and 5 meters in width, and situated in a small rocky gorge as shown on the accompanying view. From the small reservoir formed by this weir the water flows into a sand box 1.50 meters wide, 3 meters long, and 1.50 meters deep, provided with a sluice gate and a 5-inch overflow pipe. The box is constructed of reinforced concrete and prevents any sand or fine gravel from entering the supply pipe during the periods of rapid run-off from the watershed area at times of heavy rainfall.



The concrete standpipe on Mira Hill.

### THE SUPPLY MAIN.

All steel pipes and connections from the check valve at the river crossing at Vigan to the Canyau Spring, a distance of 10,771.20



Schoolboys' parade at inauguration of the waterworks, Vigan, Ilocos Sur.

meters, are included under this heading. The pipe used for this main is a 5½ outside diameter Matheson-joint steel pipe protected with "National" coating, manufactured by the National Tube Com-

pany. Standard 5½ by 5½ by 2 inch tees were inserted for the blow-off and air-valve specials as shown on profile. Crispin 2-inch air valves, inclosed in concrete manholes with wooden covers, were installed in the line.

Parade at Vigan, Ilocos Sur; inauguration of waterworks.

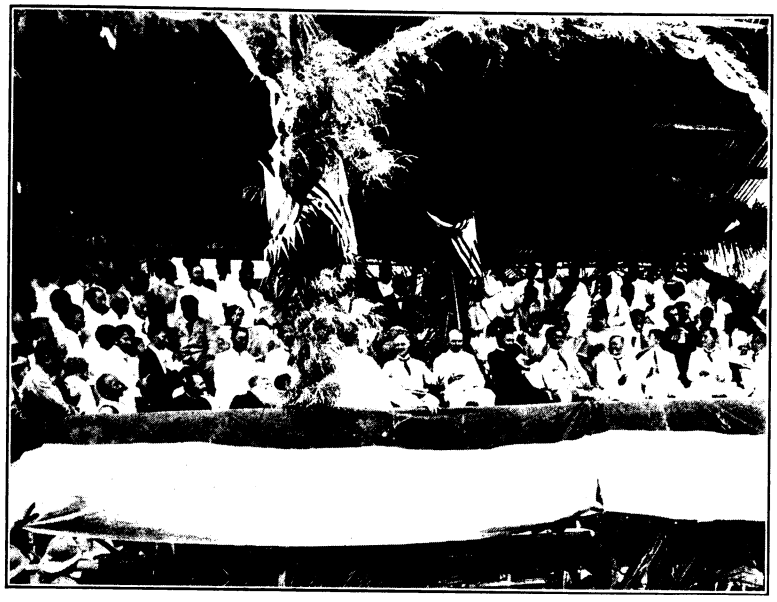
After leaving the sand box at the headworks, the pipe line passes through very rough country on its way down the mountain side. In the first kilometer six trestle bent bridges, with a total length of 180 meters, were required for supporting the pipe across the numerous ravines and gullies. These bridges were made of bents of an average height of 5.5 meters, spaced 6 meters apart; they were constructed from the left-over lumber used in the sheet piling in the river crossing.

On account of the circuitous route of the pipe line in the hills, the use of steel pipe was found to be very advantageous for the reason that the pipe could be bent to the required curvature in the field. With cast-iron pipe these curves, both horizontal and vertical and sharp in many places, would have required the use of many specials. From the standpoint of leakage also, conditions favor the use of steel pipe on account of the fewer number of joints. The average length of all steel pipe delivered gave a run of 173 joints per kilometer, while cast-iron pipe would have required approximately 273 joints per kilometer. This means that the line, if constructed of cast iron, would have had nearly 60 per cent more joints than it now contains. The item of leakage is of the utmost importance to Vigan, especially during the dry season when the flow of the spring is a minimum and the per capita consumption a maximum.

The question of cost, however, was the leading consideration in the choice of a steel main over a cast-iron one. At the foot of the mountain the pressure is approximately 200 pounds per square inch.

Gorge near spring, showing pipe line at the left, Singson Waterworks, Vigan, Ilocos Sur.

The use of cast iron for such high pressure would have required an unwarranted expenditure of funds. In this connection, the following comparison of the principal items of cost of the steel main as actually



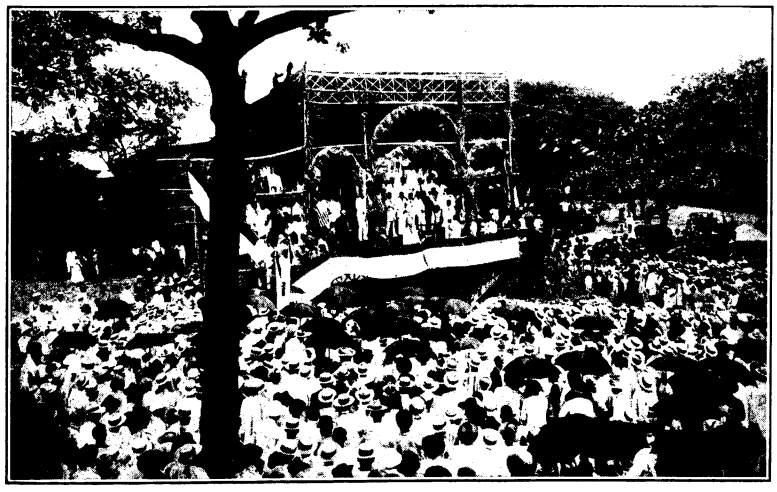
Address of Commissioner Singson, inauguration of the waterworks at Vigan, Ilocos Sur.

constructed and the estimated cost of the same main if constructed of cast iron may be of interest:

| | Cast iron. | Steel. | Difference in favor of steel pipe. |
|---|---|---|---|
| Initial cost | ₱49,307.31 | ₱26,775.69 | ₱22,531.62 |
| Lead | 3,639.44 | 922.50 | 2,716.94 |
| Laying | 3,053.16 | 2,544.30 | 508.86 |
| Transportation | 1,455.96 | 293.76 | 1,162.20 |
| Total | 57,455.87 | 30,536.25 | 26,919.62 |

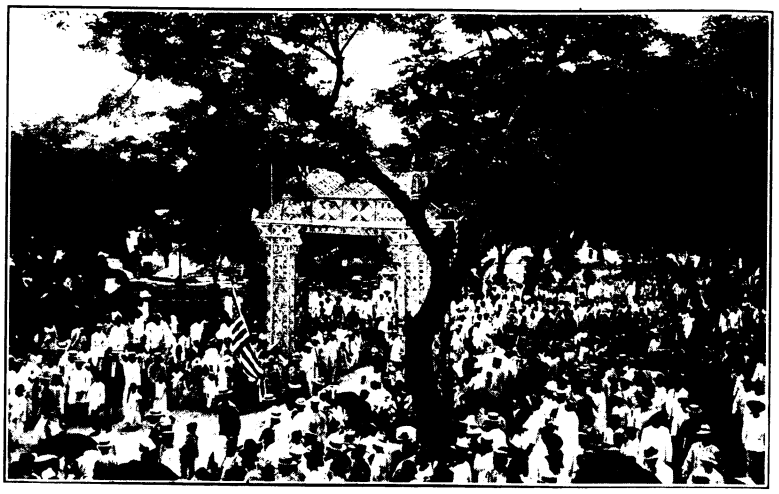
As regards a comparison of the life of the steel pipe with that of cast-iron pipe, time will be the best judge. The conditions of soil, drainage, and the quality of the water, however, are all favorable for successful use of steel pipe.

Near kilometer post No. 9, the pipe line enters the Manila–North Road and is located along the roadside thence to Vigan. It is laid under the sodded shoulder on the side of the road where the excavation interfered least with the road surface and with traffic.



Address of Governor-General, Singson Waterworks opening, Vigan, August 15, 1915.

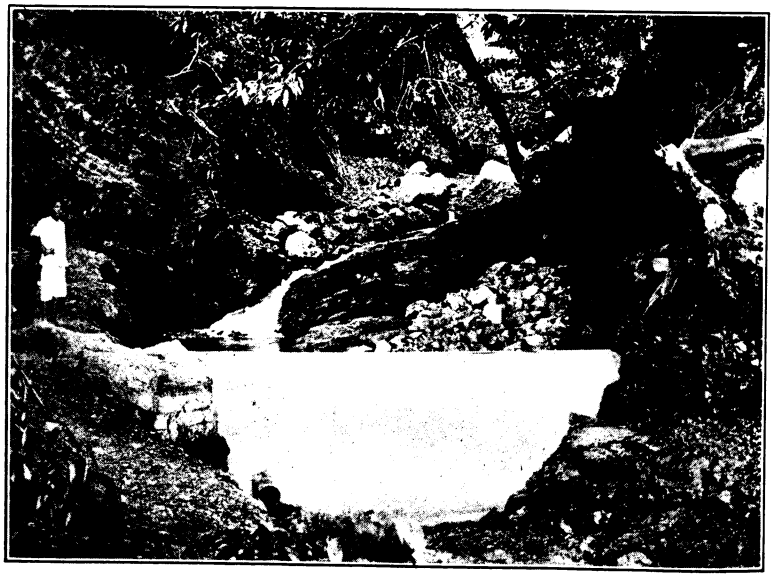
The river section between Bantay and Vigan serves as an overflow for the Abra River at flood stages, and, on account of the sand and gravel formation, it was necessary to drive sheet piles for 200 meters of the crossing in order to bury the pipe below the scour line. During the dry months the water plane is within 15 centimeters of the surface and the large amount of ground water that was



Parade at Vigan, Ilocos Sur, Singson Waterworks opening, August 15, 1915.

encountered required the use of an 8-inch Gould centrifugal pump to keep the water from rising in the trench during pipe laying. All joints, within the sheet-pile section, were calked with lead wool, which was found to produce a stronger and a more flexible joint and is capable of withstanding greater pressure than the ordinary lead joint.

In laying the steel pipe, considerable difficulty was experienced from the expansion of the same caused by the large range of temperature between midday and night. This would have been overcome to a large extent by the insertion of a slip joint at every kilometer. After new lengths had been cut in at the points where the pipes had pulled apart and the main immediately filled with water, these new joints gave no more trouble. All of the supply main was tested by the application of 240 pounds pressure per square inch. The maximum flow in the pipe, as installed, is calculated to be 350,000 United States gallons per day. This flow, together with the storage in the standpipe, should be ample to suppliy the town during times of maximum draft.



Weir at headworks—5½-inch supply main at right and 8-inch sluice pipe at lower left. Singson Waterworks, Vigan, Ilocos Sur.

THE DISTRIBUTION SYSTEM.

All cast-iron and galvanized-iron pipes, from the check valve at the river crossing to the valve at the standpipe, are considered as included under this subdivision. Trench excavation and pipe laying

for the distribution system and the supply main were accomplished by the "paquiao" system. The prices paid for excavation are as follows:

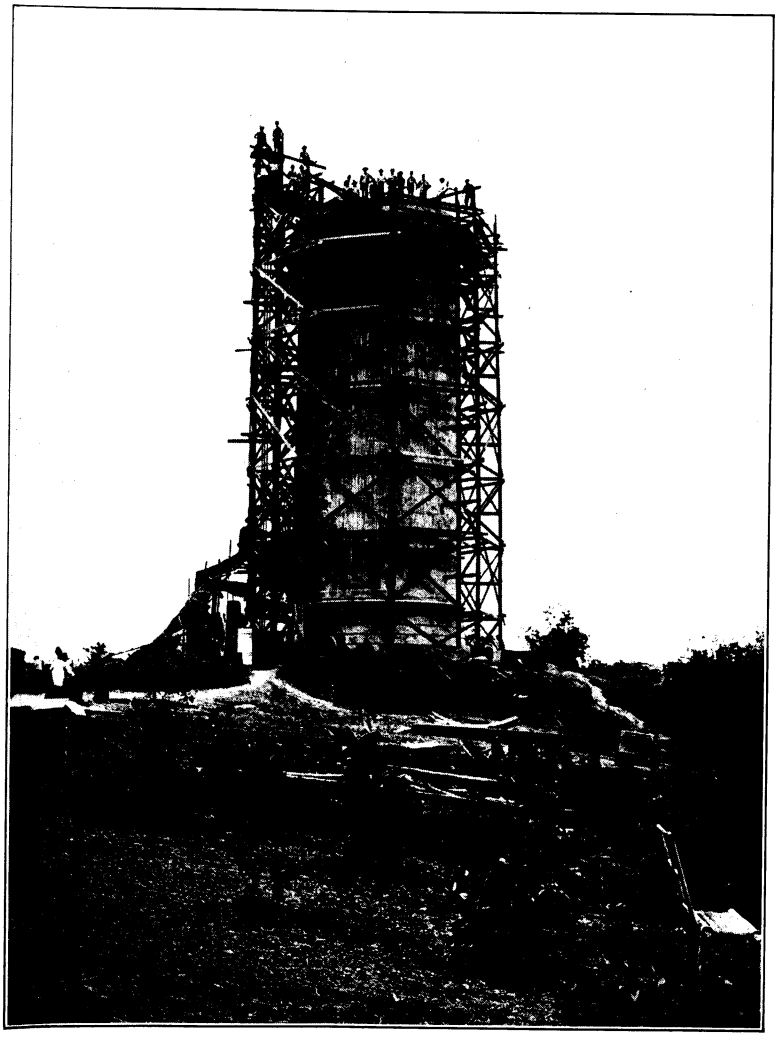
| | |
|---|---|
| Earth, including backfill, per cubic meter | ₱0.30 |
| Gravel, including backfill, per cubic meter | .40 |
| Adobe stone, including backfill, per cubic meter | .60 |

The following are the prices paid for laying pipe:

| | |
|---|---|
| 8-inch cast-iron pipe, per linear meter | ₱0.40 |
| 6-inch cast-iron pipe, per linear meter | .30 |
| 5½-inch steel pipe, per linear meter | .25 |
| 4-inch steel pipe, per linear meter | .20 |
| 2-inch galvanized-iron pipe, per linear meter | .12 |

Fire hydrants were set for ₱1 per hydrant.

To the native laborer of Vigan, the actual work of laying water pipe was a new thing, and the writer was busily occupied for a week

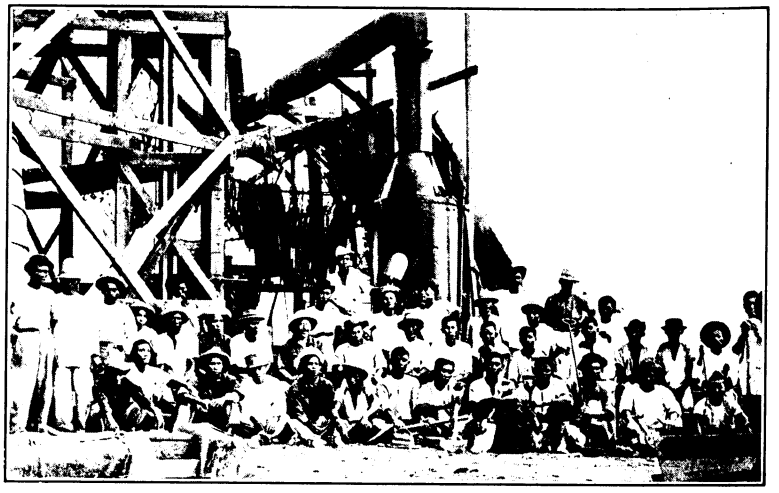


Concrete standpipe, showing scaffolding and elevator tower, Singson Waterworks, Vigan, Ilocos Sur.

giving demonstrations and teaching the contractor's blacksmiths how to cut pipe, melt lead without burning it, and calk the lead into a joint after it had been properly poured. At first, the work of the local laborers was not satisfactory, and it was thought for a time that it would be necessary to bring pipe men from Manila. However, after the first test the contractor realized how it would affect his profits if he were obliged to recalk leaky joints continually, and, as a result, the workmanship was materially improved.

All cast-iron pipe came in the standard lengths, and conformed to the American waterworks specifications. Two pipes were leaded together on the surface, thus requiring alternate joints to be poured in the trench. Care was exercised in lowering the two pipes into the trench so as not to rupture the lead in the poured joint. All joints made on the surface proved superior to those made in the trench, which fact goes to prove that it is more difficult to rigidly inspect trench work.

All pipes and connections in the distribution system were tested by the application of a pressure of 125 pounds per square inch furnished by a steam pump installed at the river crossing. The first



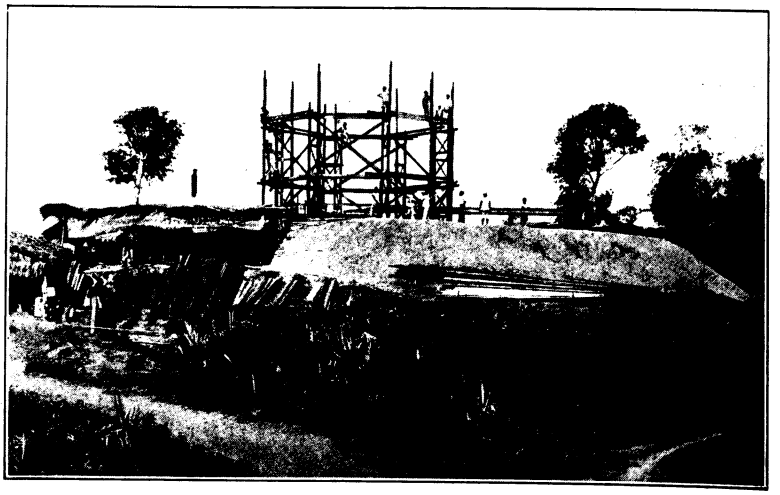
The standpipe crew, Singson Waterworks, Vigan, Ilocos Sur.

line so tested developed leaks at nearly every trench-made joint. This caused the contractor to exert a closer supervision, and naturally the pipe calkers became more skilled, so that at the last test of 1,245 meters of 6-inch pipe only two leaky joints developed.

For fire purposes the 4-inch Corey hydrants with two 2½-inch hose connections were installed at the street intersections as shown on the plan of the distribution system. At the south bank of the river crossing, where the cast-iron pipe connects with the 5½-inch steel supply main, a 6-inch check valve was installed to prevent automatically the draining of the tank and distribution system in case of a break in the steel supply main.

The total length of pipe laid within the town is as follows:

| | Meters. |
|---|---|
| 8-inch cast-iron pipe, B. & S. | 731.06 |
| 6-inch cast-iron pipe, B. & S. | 4,321.70 |
| 4-inch cast-iron pipe, B. & S. | 122.42 |
| 2-inch cast-iron pipe, B. & S. | 53.40 |
| Total | 5,228.58 |
| 4-inch Corey fire hydrants | 45 |

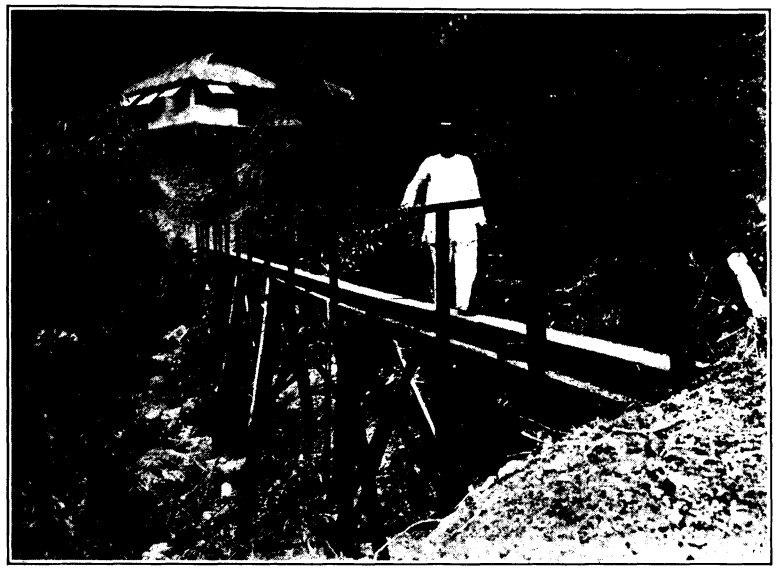


The first 6 meters of scaffolding for standpipe construction, Singson Waterworks, Vigan, Ilocos Sur.

THE MIRA HILL CONCRETE STANDPIPE.

This standpipe is located about 800 meters in a southwesterly direction from the town of Vigan on a small hill which rises about 23 meters in elevation above the average level of the town proper. The

tank has an inside diameter of 6.80 meters for a height of 12.05 meters, above which the diameter is 6.94 meters. Its capacity is 200,000 United States gallons, and its function is the same as that of a storage reservoir. The tank is of such a capacity as to supply in case of fire sufficient water, together with the constant inflow from the spring, to maintain for three hours four fire streams of approximately 125 United States gallons each, issuing from $\frac{7}{8}$-inch nozzles at the end of 90 meters of $2\frac{1}{2}$-inch rubber-lined hose. The pressure during this time is sufficient to give the stream an effective horizontal range of at least 13 meters and an effective vertical height of at least 15 meters, and at the end of this time the storage in the tank is calculated to be reduced by only one-third, and the initial pressure by only 10 pounds per square inch.

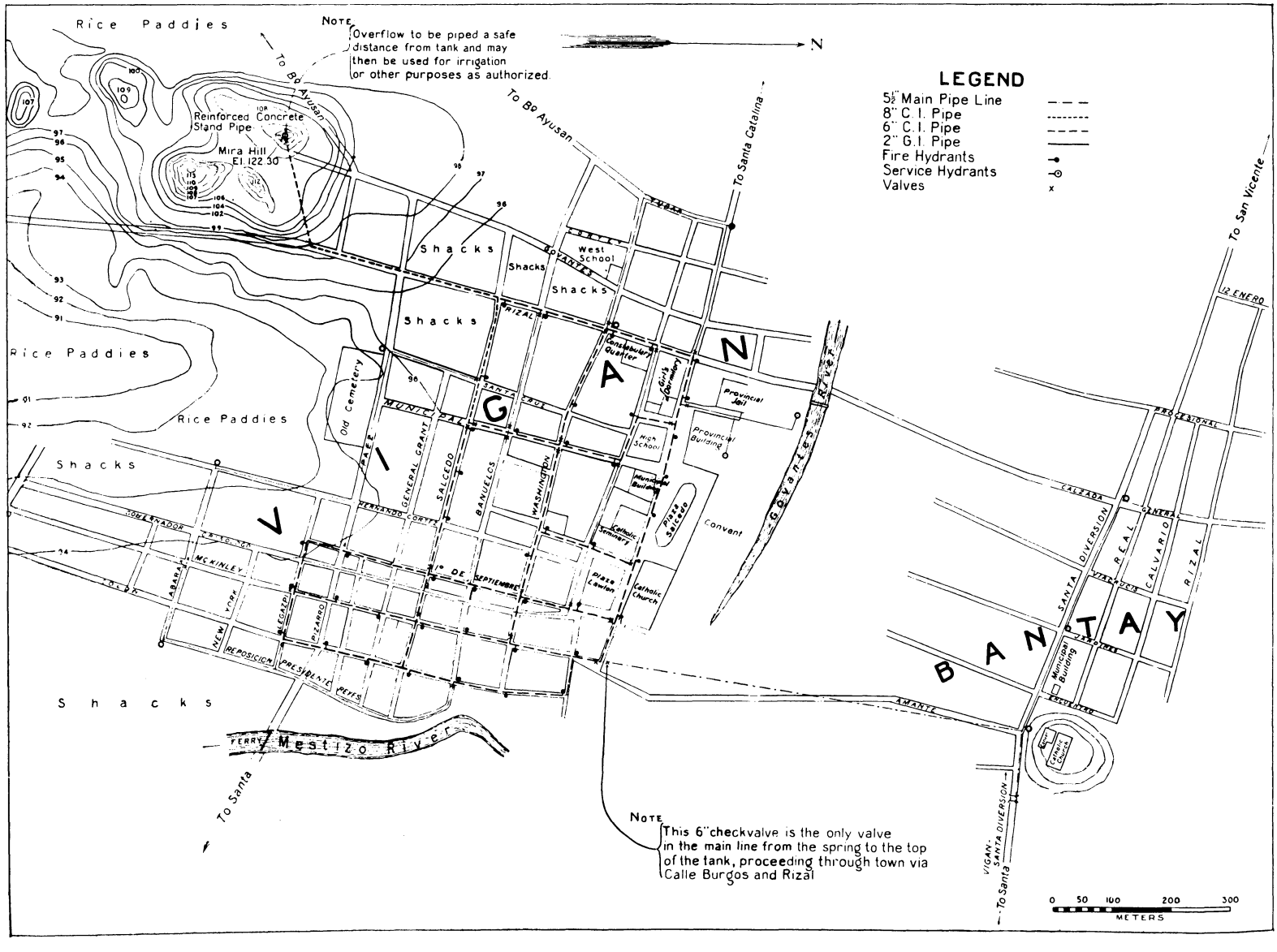


Trestle-bent bridge supporting supply main, caretaker's house in the background, Singson Waterworks, Vigan, Ilocos Sur.

The use of the standpipe allows a greater range of utility in the distribution system, making it possible to supply the town of Vigan for a period of twenty-four hours without the aid of the supply main from the spring. Operating under such conditions, the tank will provide for a per capita consumption of 20 United States gallons in twenty-four hours.

On December 16, 1914, work was started cutting down the summit of Mira Hill from elevation 122.50 to elevation 118.85, and the material removed was so deposited as to make the top circular with the tank foundation located in the central portion and on solid ground. No forms were required for the foundation slab; the earth, being very firm, stood vertical for the necessary 1.50 meter cut. The excavated material was a very hard and compact mixture of clay and sand, requiring the constant use of picks and crowbars. When loosened, the material would fall off in large chunks.

The foundation floor slab and tank shell were made of 1:2:4 concrete to elevation 4.30 and the remainder of the tank consists of a

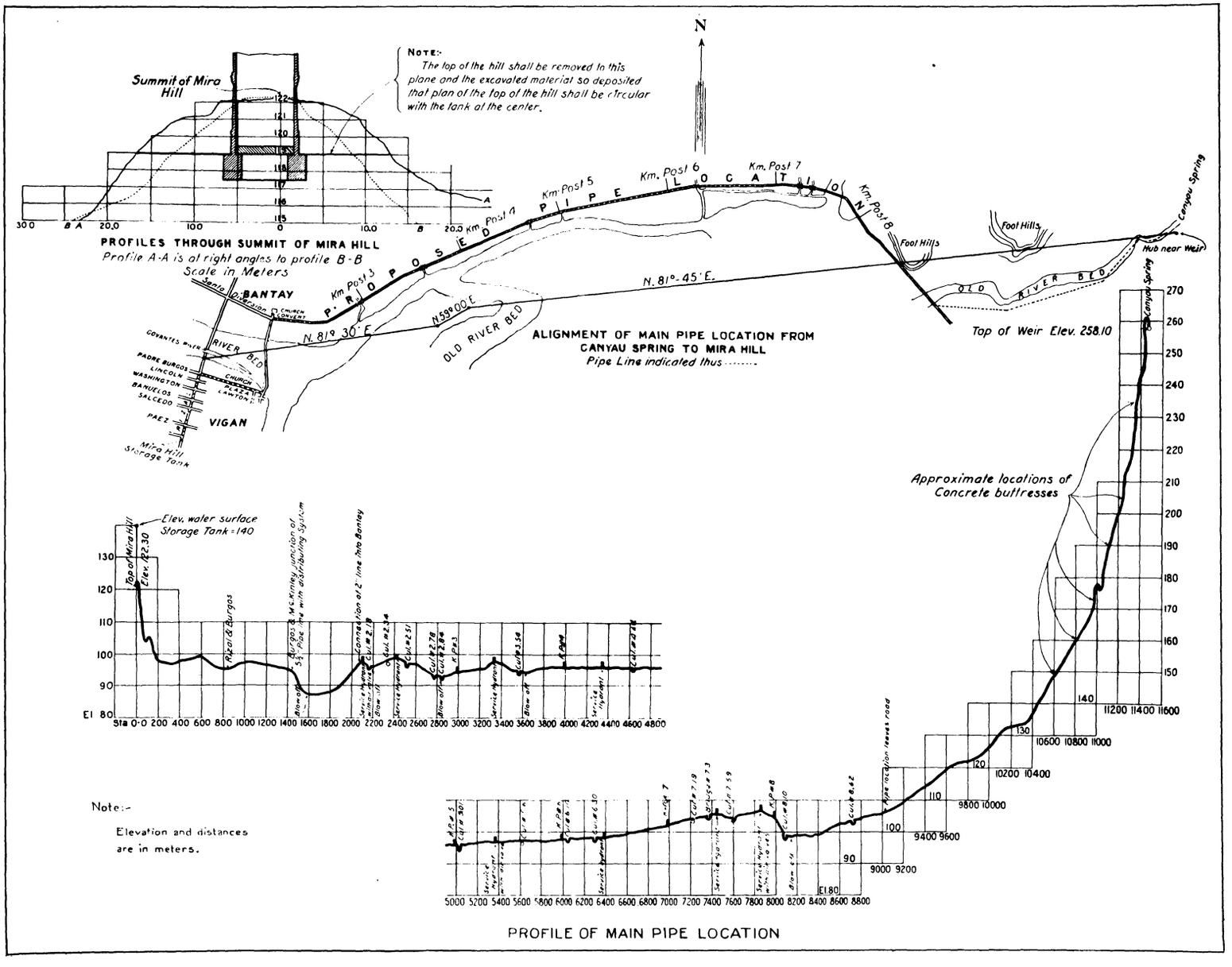


1:1½:3 mixture. This change was due to the quality of the sand, which, upon being tested, was found to be too fine and uniform for a water-tight concrete of a 1:2:4 mixture. All concrete, except the foundation slab, was waterproofed with the Truss-Con waterproofing paste by the integral method. After the completion of the foundation and floor section, two of the 3-meter sections of the outside staging were erected as shown in the view so as to support the vertical and hoop reinforcement for the shell section. Circular templets were made to keep the vertical bars and the 2-inch overflow pipes in a true vertical plane. These templets were supported by staging and were centered carefully with a transit. The inside and outside circular wall forms were placed first with reference to the vertical steel and then finally checked as to location with a transit.

The outside staging was made up of eight bents or frames, including the elevator tower as one bent, from two 4 by 6 inch posts braced horizontally with 2 by 6 inch pieces every meter and a half in height, with counter bracings of 2 by 4 inch pieces spaced every alternate panel. These individual bents were connected by cross and counter braces of 2 by 6 inch pieces in alternate panels of 3 meters in height. The inside scaffolding was made up of heavy bamboo which served the purpose of supporting a spading platform and also for supporting the concrete distributing hopper and chutes which received the concrete through a chute from the elevator tower. The tower at first caused the scaffolding to vibrate, but this vibration was readily overcome by binding the staging with cables every 5 meters in height, and then placing 2 by 6 inch struts between the scaffoldings and the finished wall. All chutes, the hoppers, and the concrete hoisting bucket were made from iron cement barrels and scrap pieces of reinforcing steel and form lumber by the blacksmith and carpenters.

The inside and outside wall forms were made up in segments of eight to the circumference. The main horizontal frames were cut from 2 by 12 inch lumber, and two of these were placed at each end of the form with one in the center spaced and braced vertically with 2 by 2 inch pieces so as to measure 6 feet in height. To these segmental frames were nailed 1 by 4 inch strips spaced 8 centimeters apart and these were covered with two pieces of No. 22 gauge galvanized-iron 3 feet in width. This style of form was very rigid and the open spaces gave it the light weight desired for use on the scaffolding. No wires or bolts for fastening the forms were allowed to pass through the concrete wall. For this reason, and on account of the ornamental base and the capital, it was necessary to have a strong and rigid outside scaffolding to support properly the inside and outside forms. All forms were thoroughly oiled with crude oil before being reset.

After the foundation had set for seven days it was cleaned, oiled



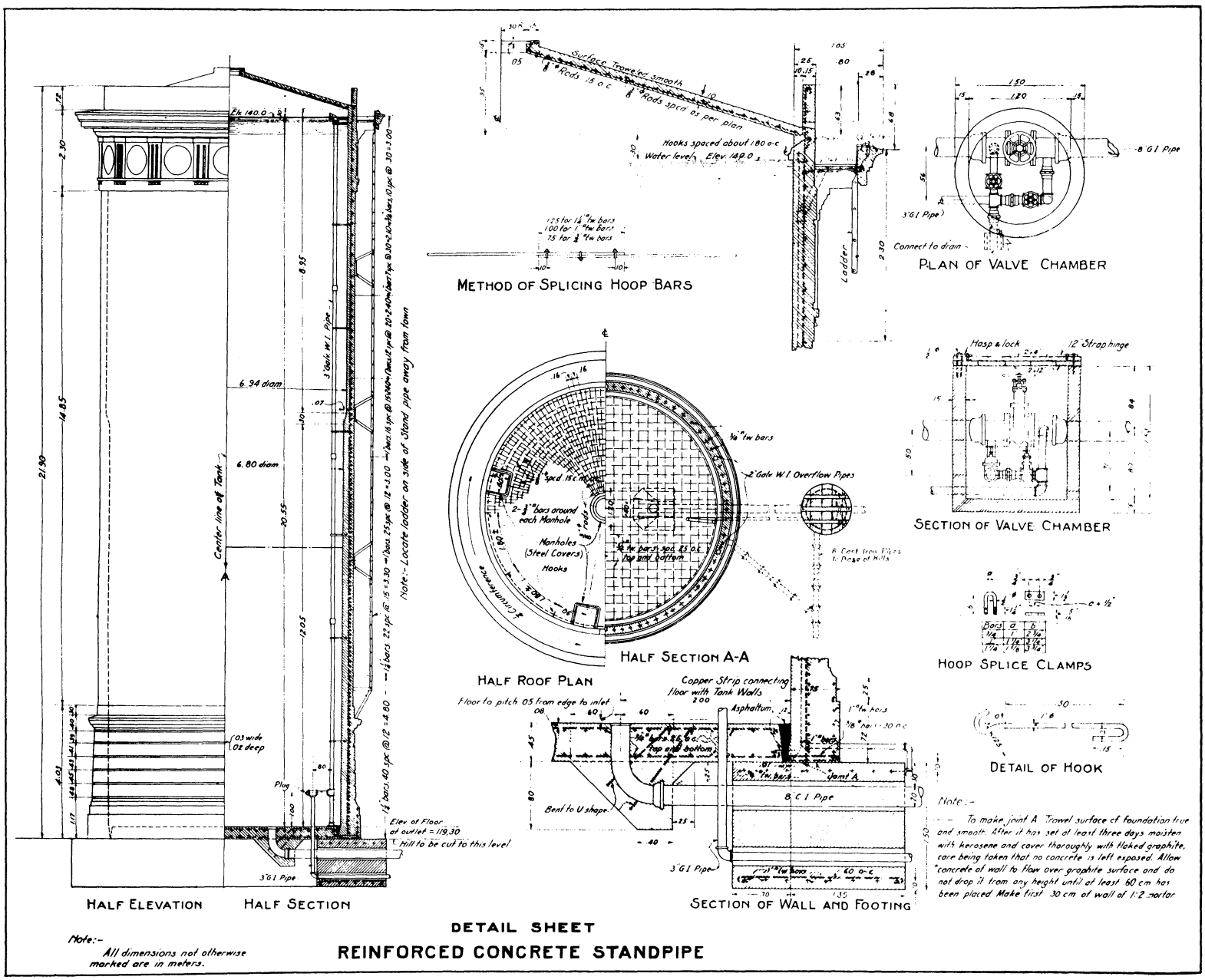
with kerosene, and then sprinkled with flaked graphite as described on the detail sheet of the plans of the standpipe. It is noted on the drawing that an asphalt joint is placed around the floor. As an extra precaution, a copper strip was inserted at this slip joint connecting the floor section with the main wall of the tank. The intention of this work is to prevent, in case of excessive vibration, the asphaltum from blowing out.

Each ring of the hoop reinforcement was made up of three bars bent to the proper radius by a hand-power bending machine. The bars were lapped 40 diameters and securely fastened by three clamps as shown on the detail sheet of the plans of the tank. Great care was exercised at all times while pouring the concrete to embed the steel properly, and spading was continuously carried on to avoid blow holes or spongy concrete. It usually required ten hours to fill the 6-foot forms, and about two to three days between pourings to knock down the circular forms, place the steel, erect the scaffolding and reset the wall forms. Between each day's work the concrete in the walls was offset so as to be Z-shaped on the radial profile. However, in the lower portions of the tank thin metal strips were placed in the concrete between each day's work.

The nearest water supply was an old well located about 200 meters from the tank site at the base of the hill. The small capacity of this well required the water carriers to fill the barrels at the charging platform one day in advance of the pouring.

About 28 laborers and 12 carpenters were continually employed in the construction of the tank. The laborers received ₱0.40 per day, capataces from ₱1 to ₱2, and the carpenters from ₱0.75 to ₱1.75. The unit cost of 1:1½:3 concrete was approximately ₱48 per cubic meter. Sand was delivered at the site for ₱1 per cubic meter and 1-inch gravel for ₱2. The hoisting engine and concrete mixer were both rented from the Province of Ilocos Sur at a monthly rate of ₱100.

The tank is now being tested by filling it with water in stages of 3 meters increase of depth at intervals of one month between these stages. At present the tank is a little more than one-half full. A few small seepage leaks (see view) have developed between portions of the concrete shell poured on successive days. When these tests are completed an article will be written for the QUARTERLY BULLETIN dealing with the tank as a waterproof structure and its action under full load.



*Construction costs, Singson Waterworks, to July 16, 1915.*

| | Certified expenditures. | Surcharges. | Total certified expenditures. | Percentage of total. |
|---|---|---|---|---|
| Headworks at spring | ₱1,806.08 | ₱156.37 | ₱1,962.45 | 2 |
| Supply main from spring to river at Vigan | 34,492.39 | 2,986.15 | 37,478.54 | 34 |
| Distribution system from river to standpipe | 42,761.93 | 3,702.13 | 46,464.06 | 42 |
| Standpipe | 21,830.02 | 1,915.95 | 23,745.97 | 22 |
| Total | 100,890.42 | 8,760.60 | 109,651.02 | |
| Obligations: | | | | |
| Materials (meters, service pipes, etc.) | | | 2,678.00 | |
| Contract (extra amount of steel pipe contract) | | | 1,500.00 | |
| Installation (maintenance of distribution system, July to December | | | 1,500.00 | |
| Provincial surcharge (5 per cent) | | | 283.90 | |
| Insular surcharge (3 per cent) | | | 178.86 | |
| Grand total | | | 115,791.78 | |
| Appropriation | | | 120,774.78 | |
| Balance | | | 4,983.19 | |

## TWO GRAPHICAL SOLUTIONS OF THE "ENGINEERING NEWS" FORMULA FOR PILE DRIVING.

By W. C. WEST, Assoc. M. Am. Soc. C. E.

The formula as given in English units, $P=\frac{2wh}{S+1}$, is not especially difficult of solution by mental process, which probably accounts in some measure for its popularity, but when transformed into its metric equivalent it is by no means as easily handled. The Bureau standard specifications give it in the following form:

$$L=\frac{50\ km}{3c+7.62}$$

in which $L$ is the safe load on the pile and $k$ the weight of the hammer, both in kilos or metric tons; $m$ is the height of free fall of the hammer in meters, and $c$ is the average penetration per blow, in centimeters. In this form, and taken in connection with the fact that generally the hammer has been cast to an even English weight, the formula might easily present the following problem for solution:

$$L=\frac{50\times 0.91\times 3.6}{(3\times 4.2)+7.62}$$

and even a mathematical prodigy would be likely to reach for pencil and paper.

*Solution No. I, by a nomograph.*—A nomograph of a formula may be defined as "a plot or chart on which appear scales for the variables involved in the formula, their relative magnitudes and relative positions being such that corresponding values of the variables are found on a line crossing the scales. By the expression 'corresponding values' is meant a set of values which satisfy the equation represented by the nomograph; and the crossing line, therefore, is properly termed an isopleth."[1]

To transform the formula under consideration for nomographic representation:

$$L=\frac{50km}{3c+7.62}=\frac{16.67km}{c+2.5}$$

whence,

$$\frac{L}{16.67\ k}=\frac{m}{c+2.5}$$

and,

$$\log\left(\frac{L}{16.67\ k}\right)=\log m-\log\,(c+2.5)$$

Now, let

$$\log\left(\frac{L}{16.67\ k}\right)=2b$$
$$\log m=a$$
$$\log\,(c+2.5)=c$$

The resulting equation,

$$b=\tfrac{1}{2}\,(a-c)$$

[1] R. C. Strachan, M. Am. Soc. Co. E., in *Proceedings*, Dec., 1914.

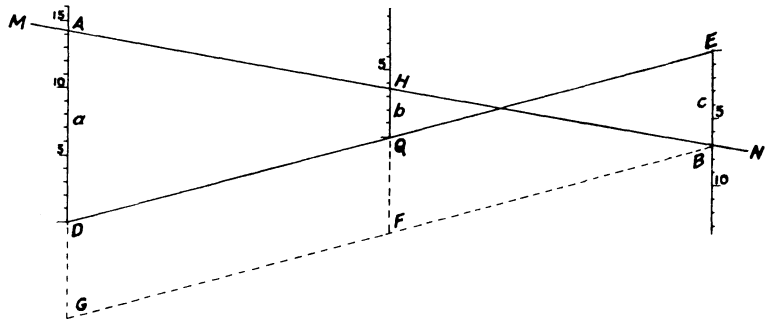



Fig. 1.

is illustrated by figure 1, which shows three parallel scales of equal parts, starting from the common base line $DE$. The $a$ and $b$ scales read upward and the $c$ scale downward. The $b$ scale is placed equidistant from the other two. By drawing $BG$ parallel to $DE$ through $AD$ and $HQ$ produced, it is at once apparent that—

$$HF=\tfrac{1}{2}\,AG$$

but,

$$HF=HQ+QF=b+c$$

and,

$$AG=AD+DG=a+c$$

hence,

$$b+c=\tfrac{1}{2}\,(a+c)$$

and,

$$b=\tfrac{1}{2}\,(a-c)$$

Now, if the three scales are made logarithmic instead of scales of equal parts, and the $b$ scale is made half the size of the others, we shall have,

$$b=\frac{a}{c}\ \text{or}\ \frac{L}{16.67\ k}=\frac{m}{c+2.5},$$

the orignal equation.

To solve for $L$, transpose,

$$L=\frac{m}{c+2.5}(16.67k)$$

and perform the multiplication direct by shifting the $b$ logarithmic scale downward until the reading 16.67 $k$ coincides with the point $Q$. The reading at $H$ will then be the value of $L$.

The practical nomograph is shown by figure 2, in which, as here printed, the central scale is set for a 1-tonne hammer, with the value of 16.67 $k$=16.67 set at the point $Q$ in the center of the nomograph. The dotted line shows the isopleth in position for a 6-meter drop of the hammer and a 1.5-centimeter penetration. The 2.5 is added mentally, giving 4.0 on the right-hand scale. The safe load on the pile, as read on the central scale, is 25 tonnes.

To adapt the nomograph to the use of any particular weight of hammer, the central scale may be copied on a strip of paper and the strip pasted over the original scale, placing the reading 16.67 $k$ in exact coincidence with the point $Q$. Thus, for a hammer weighing 910 kilos, or 0.91 tonnes, the setting of the "safe load" scale would be 15.17 tonnes, a 1.5-tonne hammer would require a setting of 25 tonnes, etc.

Any straightedge will, of course, serve for the isopleth; but a better one is a straight line scratched on a piece of transparent celluloid—a length of photographic film, for example—or an ordinary "amber" triangle.

*Solution No. II, by diagrams (fig. 3).*—Here the formula is transformed as shown, and the arguments $c+2.5$, $m$, and $k$ are used in the order named. For example, suppose a 1.5-tonne hammer is being used, and that for a drop of 3 meters a penetration of 10 centimeters is obtained. Add 2.5 mentally, start with 12.5 at the left of the upper diagram, proceed horizontally to the point where this reading intersects the line marked "$m$=3.0," drop vertically to the lower diagram until the line marked "$k$=1.5" is encountered, and then proceed horizontally to the reading $L$=6.0 tonnes at the left. For an actual penetration of 4.5 centimeters and a drop of 4 meters, use the line marked "$k$=1.5: multiply $L$ by 10," on the lower diagram, the value of $L$ in this case being 14.3 tonnes. For a value of $c+2.5$

of 4.0, and a drop of 6 meters, use the line marked "$m=6.0$: multiply L *by* 10," and read $L=37.5$ tonnes on the lower diagram.

When the hammer weighs exactly 1,000 kilos, the lower diagram becomes unnecessary, the values of $L$ being read directly on the horizontal line between the two diagrams. For use in the field with a particular hammer, it is suggested that two slanting lines be drawn in red ink on the lower diagram, corresponding to the exact weight of that hammer. To draw these lines, find a point on each vertical edge of the lower diagram which reads the exact weight of the hammer in tonnes, and draw the red lines through these points parallel to the other slanting lines on the diagram.

Both nomograph and diagram may be used with Eytelwein's formula [1] for driving concrete piles, with but small mental effort to

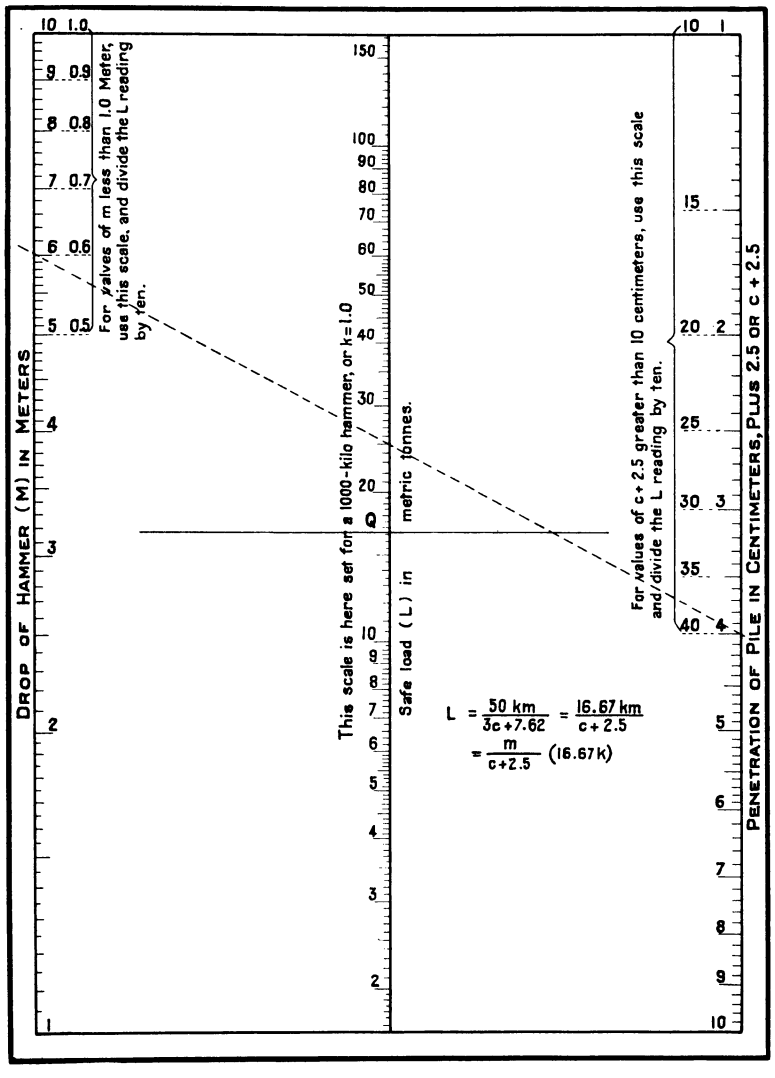



Fig. 2.

prepare the "penetration" argument. Transformed into metric equivalents, the formula reads as follows:

$$L=\frac{16.67\ km}{c\left(1+\frac{p}{k}\right)}$$

in which $p$ is the weight of the pile in kilos or metric tonnes. The other letters have the same signification as in the "Engineering News" formula just discussed. The quantity $1+(p\div k)$ should be calculated when the job is commenced for the particular pile and hammer used. Thus, for a 10-meter standard reinforced-concrete pile and a hammer weighing 1,520 kilos, Eytelwein's formula would read:

$$L=\frac{16.67\ km}{3.2c}$$

[1] Jacoby and Davis: Foundations of Bridges and Buildings, 1914.

the quantity $3.2c$ being the "penetration" argument to use with either nomograph or diagram. The nomograph is especially valuable for use with this formula, since in order to use the penetration $c$ directly it is only necessary to slide the right-hand scale downward until the

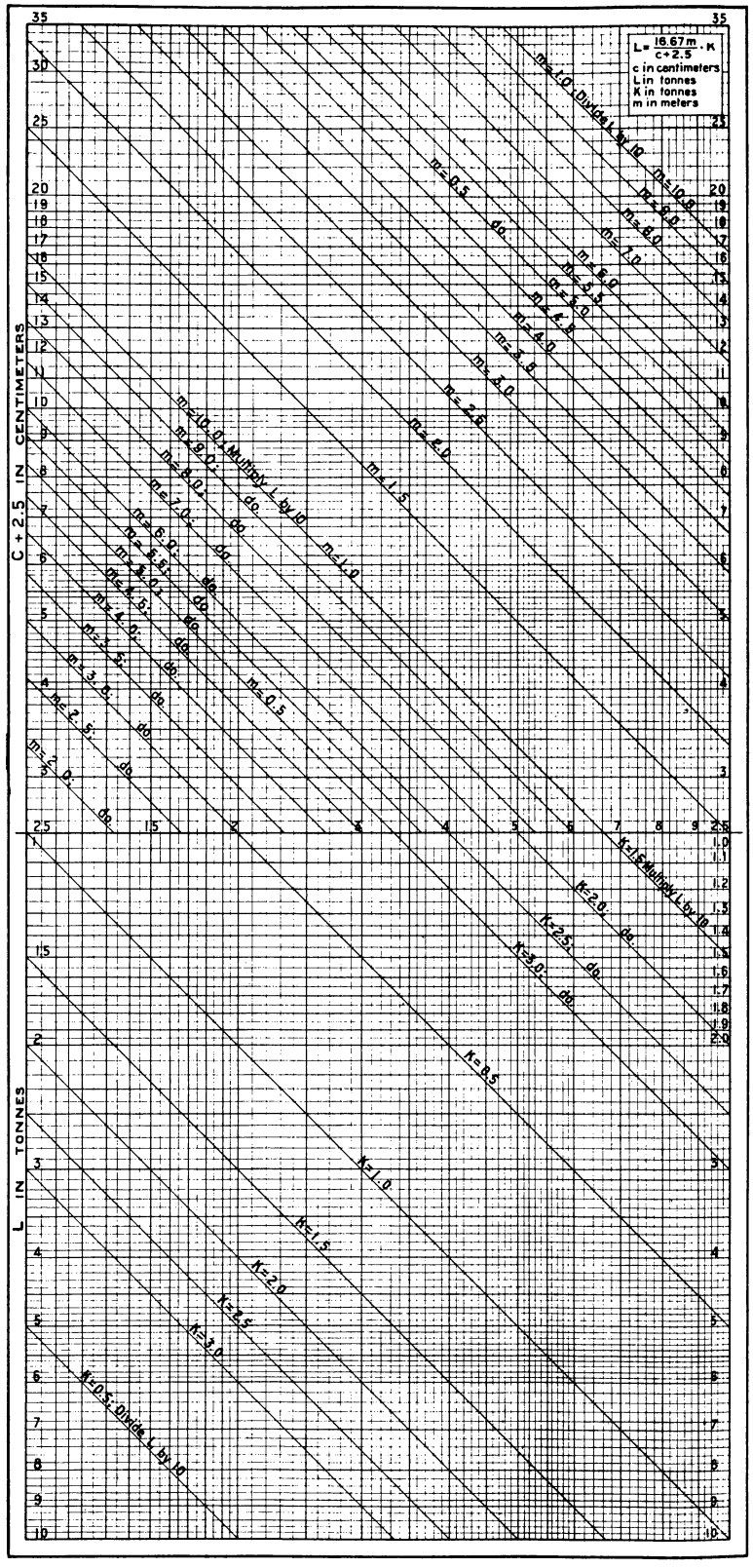



Fig. 3.

reading 1.0 thereon coincides with the reading of the coefficient of $c$ on the scale as printed, easily accomplished by copying the scale on a strip of paper and pasting same over the original scale in the proper position.

As an instance of the importance of taking the weight of the pile

into consideration, apply the formulas to the following two sets of conditions:

(*a*) $k=1.0$, $m=6.0$, $c=4.0$, $p=3.0$
(*b*) $k=2.0$, $m=3.0$, $c=4.0$, $p=3.0$

It will be noted that $km$, the force of the blow in kilogram-meters, is the same for both sets. The "Engineering News" formula gives the same bearing power for both sets, $p$ not being considered at all. Eytelwein's formula, however, gives $L=6.2$ for (*a*) and $L=10.0$ for (*b*), an expression, at least, of the superiority of the heavier hammer in driving concrete piles.

## CARE OF THE ROADSIDE, TREE PLANTING, FLOWERS, AND SHRUBS.

By D. E. HENRY, Senior Supervising Engineer, Associate Member, American Society of Civil Engineers.

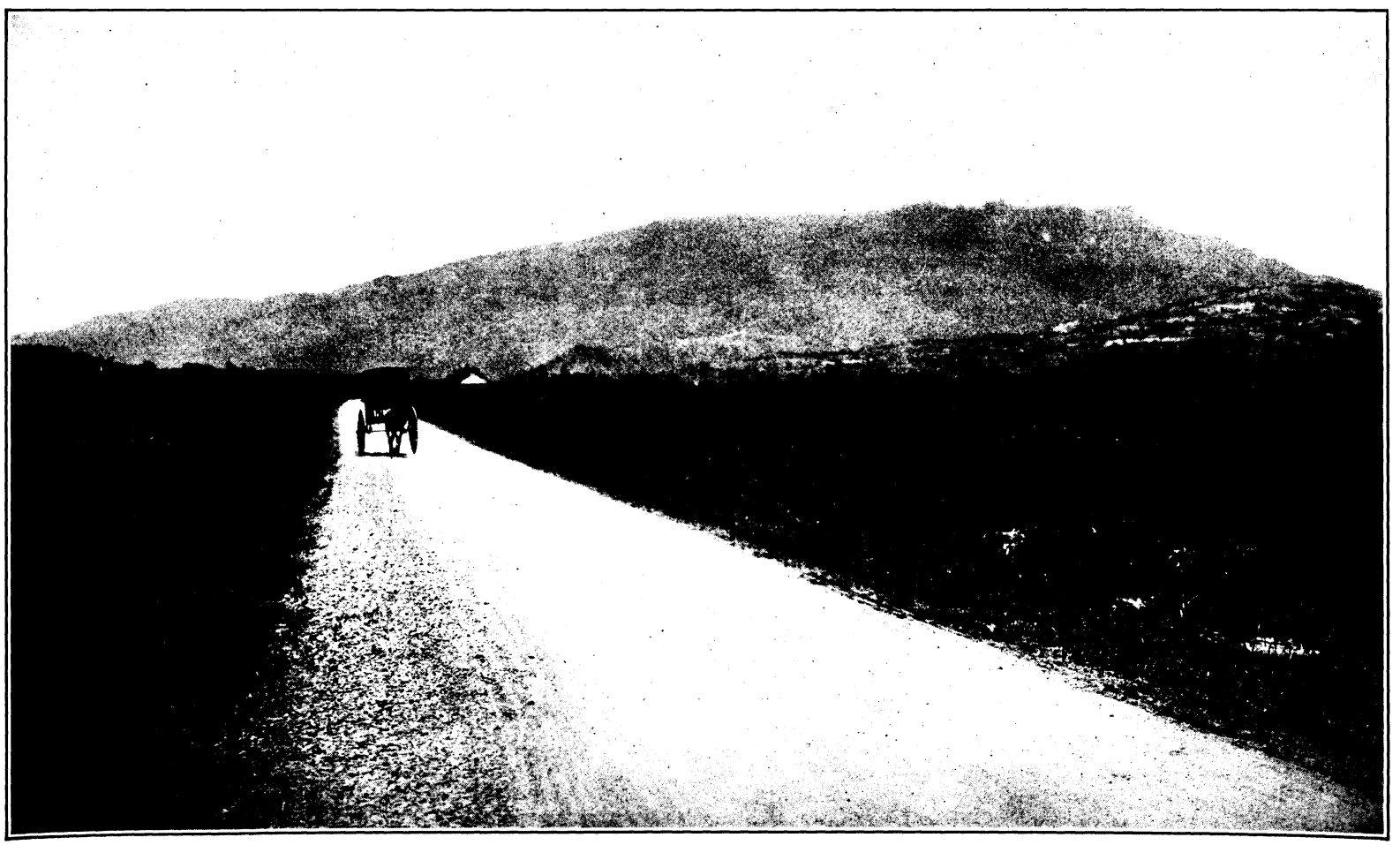
Tree planting along public highways is considered one of the difficult problems that falls to the lot of the district engineer. So much has been written and such emphasis placed upon the importance of the surfacing of our highways, that it would seem proper and timely, at this stage of highway development in the Philippine Islands, to emphasize the necessity and importance of the care of the roadside.

Since the first instructions were issued from the Bureau of Public Works, the district engineers have energetically undertaken the task assigned them. At times the lack of coöperation from those who should be the most enthusiastic—the citizens, for whom all this is done—and the difficulties encountered have been so great that some engineers have become discouraged. The first drawback was the lack of available nurseries from which to secure seeds, plants, and young trees suitable for roadside planting. With the exception of the nursery maintained by the city of Manila, from which a limited number of young trees could be purchased by the nearby provinces, there were no nurseries in the Philippine Islands, and at least one nursery had to be started in each province.

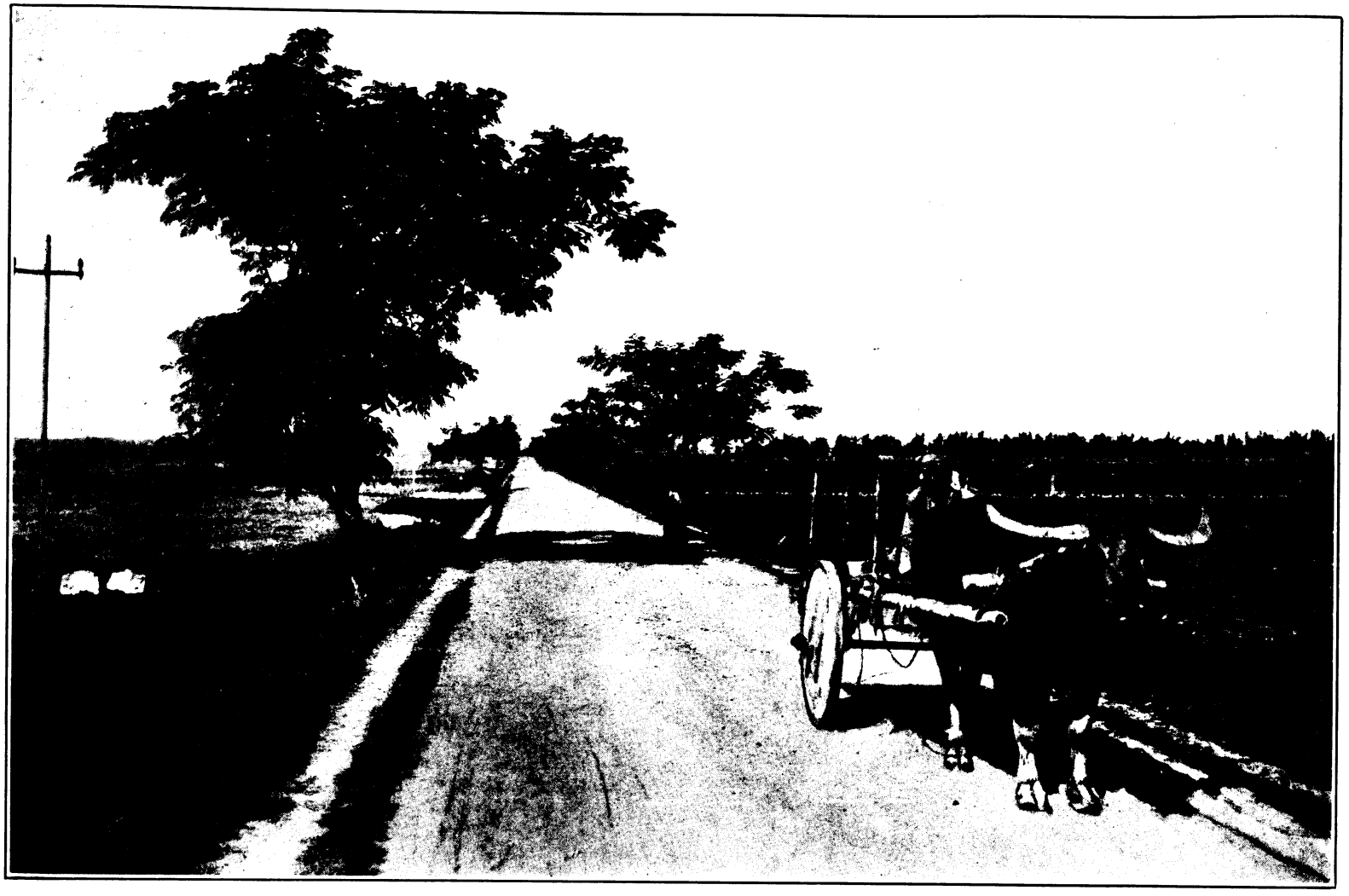
A suitable plot of ground for a nursery had to be first obtained, and this feature of the work was not a difficult matter as sometimes there was sufficient land for the purpose on the provincial grounds. If not, permission was granted by the school authorities for the nursery to be started on the school grounds, or, where public land was not available, a piece of land would be leased or bought from private parties. After a site for the nursery had been secured, it was then necessary to obtain seeds or seedlings of the various trees recommended for roadside planting. As no engineer is an expert nurseryman, even in a moderate degree, the operation of planting the seeds or seedlings and bringing them to the stage of development where they were ready for transplanting to the roadsides became a difficult proposition. The district engineers, by reading up on the subject, could acquire a theoretical knowledge of tree planting, but only from diligent and careful observation and practice, and by the knowledge obtained from their failures, was success possible.

If a favorable start was made during the wet season the seedlings and young trees had to be held in the nursery through the dry season, as the transplanting to the roadside could not be done until the beginning of the following rainy season. As a result, the watering of the plants and seedlings would be neglected for a day or so at some time during the dry season, and in consequence many of the young trees either died or were severely stunted in their growth.

The planting and care of the nursery depended upon the attention which the district engineer would give to it, his knowledge of the art coming from instructions sent out from time to time by the Bureau of Public Works. In this connection very valuable assistance has been rendered by the Bureau of Forestry, the Bureau of Science, and more recently by the inspectors from the Bureau of Agriculture. These nurseries in the provinces have been, for the most part, in



Roadside barren, Laguna Province.



Contrast possibilities. Pampanga Province.

charge of low-paid Filipinos, who had had no experience in horticultural work before, and had to acquire their experience as they went along. An effort was made to secure competent men in Manila for this work, but it was found that there were none available.

The most difficult and discouraging task is the transplanting of the seedlings to the roadside and caring for them until the tree is large enough to withstand the destructive influence of the elements, stray animals, and, in many instances, the hostile attitude of the owners of land bordering the roadside. Furthermore, it was found that different soils presented problems requiring a careful study, inasmuch as different care even for different species was necessary in order to obtain successful results, and this feature of the work consumed much time.

The young trees after being transplanted require protection against the elements, typhoons, floods, and drought, which at times caused a considerable loss, but by far the most destructive agents are the

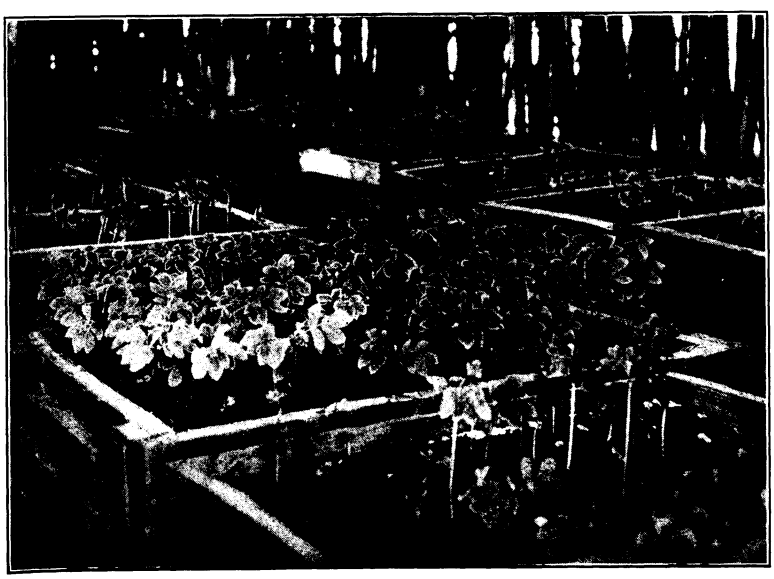
Result of foresight. Albay Province.

The picture in mind. Ilocos Norte Province.

domestic animals, which in every province are permitted to roam at large, and a tree must be hardy, indeed, or have ample protection in order to escape this source of danger. The construction of protective devices for the young trees is costly, but is absolutely necessary if steady, consistent, and satisfactory progress in roadside tree planting is to be accomplished. The unfavorable, sometimes even hostile, attitude of landowners or residents along the roadside is justifiable to a certain extent in view of the fact that the trees planted on the lines of the right of way, after attaining full growth, shade a considerable portion of cultivated land. On the other hand, the owners of land abutting on the public highways should realize that the benefiting and beautifying of the roads by tree planting gives more value to them than to their neighbors back of them and in return should be willing to concede something. They should realize that every tree they pull up or destroy represents a value and expenditure which has been paid for, at least in part, by them.

Capiz provincial nursery, September 22, 1915.

Lot of lumbang trees ready for transplanting on roadsides. These seedlings were grown from seeds of local trees (Banga, Capiz) and planted in January, 1915; 1,600 lumbang seeds procured from the Agricultural Farm, Los Baños, La Laguna, have also been set out in this nursery; 450 other saplings of lumbang have been gathered from the local forests.



Capiz provincial nursery.

Section of interior of plant shed, showing part of a lot of 5,000 acacia seedlings grown from seeds gathered in Romblon.

The writer would like to see nurseries established in every municipality throughout the Islands in which would be cultivated not only shade trees, but also fruit trees, suitable for roadside planting. This would not only benefit and beautify the right of way, but would in time, with proper management, become a source of revenue to the Government and probably solve to some extent the problem of road maintenance. The interest of the school children has, in many places, been aroused and they have become quite enthusiastic over roadside tree planting. With judicious and systematic instruction as to the proper location of the trees, the children can be of very considerable assistance to the district engineer in carrying out the work of beautifying the public highways.

Capiz provincial nursery.

Ornamental plants, including hybiscus, papua, and violetas, in the foreground; plant shed shaded with vines in the background.

A thorough coöperation between the district engineer, the municipalities, and the people will be the only means whereby this feature of highway development in the Islands can be successfully accomplished, and with this coöperation, within a reasonable time, not only posterity, but even the present generation will be benefited thereby. Through this coöperation it will be possible to secure the assistance

Capiz provincial nursery.

Bed of mango seedlings grown from seeds of fruit from local market; seeds set out in May and June, 1915. These (whole lot, about 500 plants) will be set out on roadsides in 1916.

Capiz provincial nursery.

View showing arrangement of acacia seedlings set out over large portion of nursery to provide shade for seedlings of slower growing species. Acacias and lumbangs, having a more rapid growth, are not set out in seedling beds or nursery rows. After about two months' growth in seed boxes these are transferred to bamboo joints from which, at from six to eight months' growth, they are transplanted directly on the roadsides.

of the people along the highway in obtaining shade trees of mature growth from the forests or fruit or nut bearing trees from the farms for transplanting to the roadside, which trees come to maturity in much shorter time than those raised and transplanted from the nurseries.

The question of roadside tree planting has reached a large stage of development in many European countries and in fact the great majority of highways in Europe present a similar appearance to Calle P. Burgos in the city of Manila. In the United States this work is considered one of the essentials, not only trees being planted

Transplanted trees in rice fields, Bulacan Province.

along the roadside, but in some States, where the climate will permit, the roadsides are also beautified with flowers. The Iowa State Highway Commission in their "Service Bulletin" advocate: "Growing honey plants and turning the roadsides into great bee pastures would not only hold the banks of cuts and fills and side ditches, but could net the State of Iowa millions of dollars in honey products."

The committee of standards in submitting its report to the American Road Builders' Association emphasizes the importance of this question, "The Care of the Roadside." In its report the committee states: "Millions of dollars have been expended on road surfaces, and a slight expenditure to make highways more attractive is certainly justified. It is generally admitted that the shoulders and the side ditches should be kept free from grass and weeds, and that the flow of surface water should be unobstructed; but what about the remainder of the space within the side lines of the roads? It is usually ragged, unkempt, and slovenly, and were it not for the foresight of preceding generations many of our roads would be entirely destitute of trees. Our roads are being improved to attract travel. This is done in other countries; it is done in certain parts of the United States, especially Massachusetts, and it should be accepted, generally, as an important phase of highway improvement and maintenance."

The following plan of coöperation suggests itself as both feasible and promising the accomplishment of much good: The school children should confine their efforts to the planting of flowers either at the edge of the surfacing or other portions of the right of way designated by the district engineer, the municipal authorities and residents to furnish shade trees from the forests and fruit or nut bearing trees from the farms. The district engineer to bring his nursery up to the point where any deficiencies may be supplied within a reasonable time. In the management of one provincial nursery, the district engineer requested the ladies of the province to donate seeds and plants. Each donation was assigned a separate plot in the nursery and its success or failure noted. This scheme has, so far, been very beneficial and successful.

To the writer's vision the future presents a picture of these beautiful Islands, rich in tropical verdure and with a soil unsurpassed for richness, needing only attention and development along scientific lines to enable them not only to rival Japan, Java, or Ceylon in beautiful cities and parkways, but to far surpass them in magnificent highways lined with noble trees, stately palms, beautiful shrubs, and glowing, brilliant, flowers. This vision can be made a perfect reality by the coöperation of all the people and the untiring energy of those in direct charge of the work.

Protecting young trees, Cavite Province.

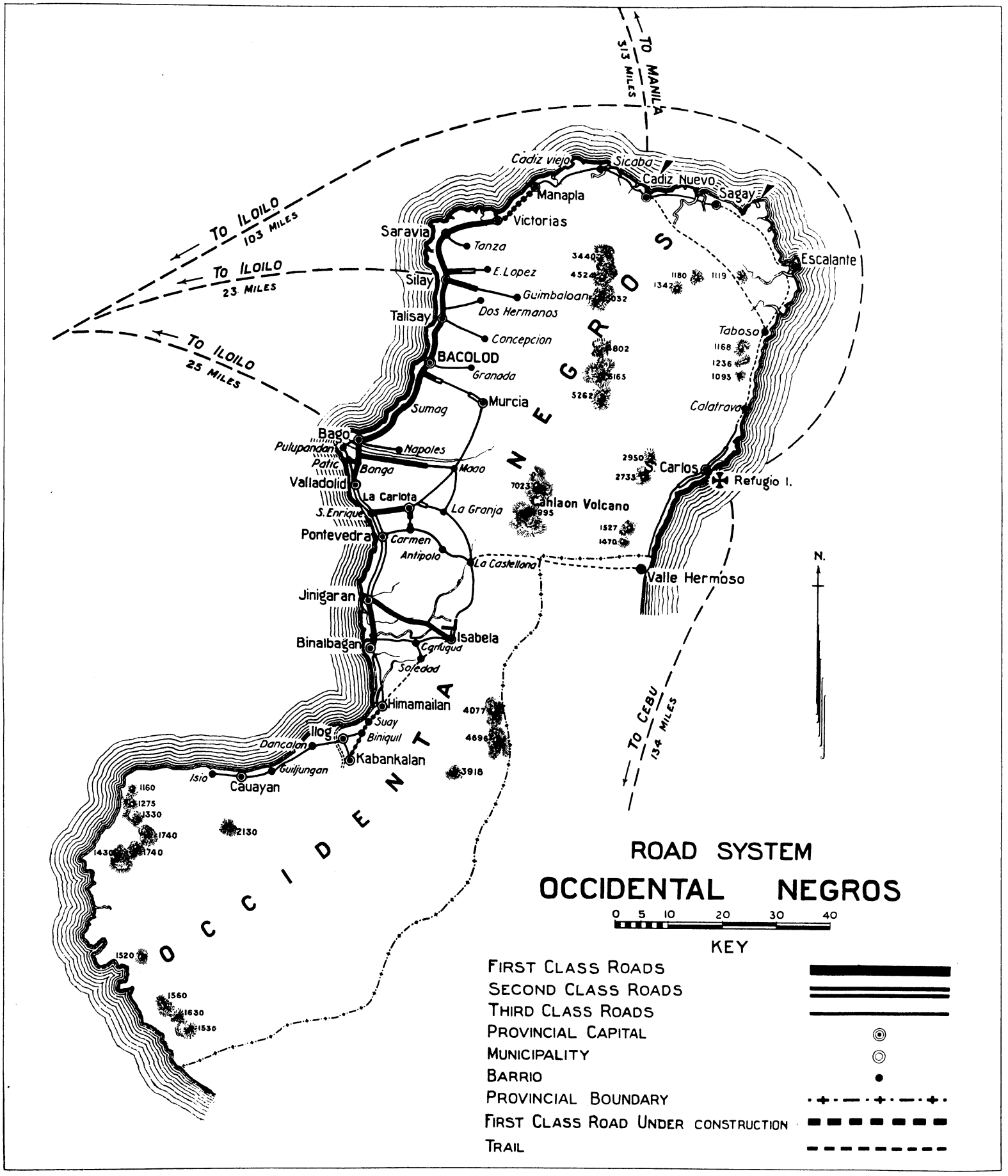
## PUBLIC WORKS IN OCCIDENTAL NEGROS.

By W. C. A. PALMER, District Engineer, Associate Member, American Society of Civil Engineers.

The Province of Occidental Negros occupies an unusually prominent position in the internal affairs of the Philippines, producing as it does the greater part of the large staple crop of sugar and representing as it does the rich and populous Visayan Islands.

The Island of Negros is located between latitude 8° 40′ and 11° 01′ north, and between longitude 122° 24′ and 123° 36′ east. It is approximately 230 kilometers long in its greatest length by about 80 kilometers in its greatest width, and has an area of 4,881 square miles. Of this, Occidental or Western Negros comprises 3,150 square miles. The central part of the island is very mountainous, with the active volcano of Kanlaon rising to 8,000 feet in the geographic center, and with the hills running clear to the sea in the north. These mountains are covered with the finest stand of timber in the Philippine Islands if not in the world, and have given rise to great progress in the lumber industry. Two large mills are in operation, one by the Negros Philippine Company in Cadiz and another and larger one at Fabrica in the municipality of Sagay by the Insular Lumber Company. The latter is the largest and most up-to-date mill in the Islands, operating seven logging engines and two band saws. The company also operates a small steamer, several launches, tugs, steel lighters, and about 10 kilometers of logging track.

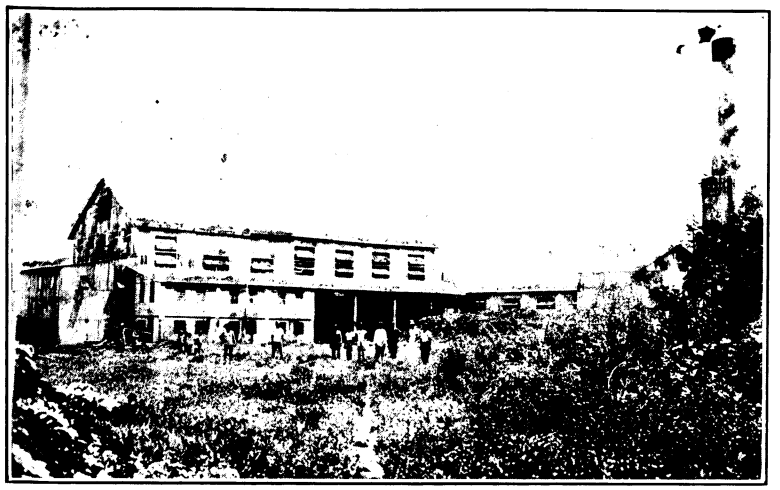
Occidental Negros has a population of nearly 400,000 persons (308,272 by the census). Of these people only about 4,000 are non-Christian, the remainder being engaged in raising sugar and rice with a small but annually increasing corn crop.


TO MANILA
313 MILES
TO ILOILO
103 MILES
TO ILOILO
23 MILES
TO ILOILO
25 MILES
Cadiz viejo
Sicoba
Cadiz Nuevo
Sagay
Manapla
Victorias
Saravia
Tanza
E. Lopez
Silay
Guimbaloan
Talisay
Dos Hermanos
Concepcion
BACOLOD
Granada
Murcia
Sumag
Bago
Pulupandan
Napoles
Pataic
Banga
Moao
Valladolid
La Carlota
S. Enrique
La Granja
Pontevedra
Carmen
Antipolo
La Castellana
Jinigaran
Binalbagan
Isabela
Cartuqud
Soledad
Himamailan
Suay
Ilog
Biniquil
Dancalan
Kabankalan
Guiljungan
Isio
Cauayan
NEGROS OCCIDENTAL
Escalante
Taboso
Calatrava
San Carlos
Refugio I.
Canlaon Volcano
Valle Hermoso
TO CEBU
134 MILES
3440
4524
1180
1119
1342
5032
1802
1168
1236
1093
5165
5262
2950
2733
7023
995
1527
1470
4077
4696
3918
1160
1275
1330
1740
1430
1740
2130
1520
1560
1630
1530
N.
ROAD SYSTEM
OCCIDENTAL NEGROS
0 5 10 20 30 40
KEY
FIRST CLASS ROADS
SECOND CLASS ROADS
THIRD CLASS ROADS
PROVINCIAL CAPITAL
MUNICIPALITY
BARRIO
PROVINCIAL BOUNDARY
FIRST CLASS ROAD UNDER CONSTRUCTION
TRAIL

Immigration is increasing the population with great rapidity. There are in the province 22 municipalities, all of which are along the coast except 4—Isabela, La Carlota, Murcia, and Kabankalan.

SUGAR.

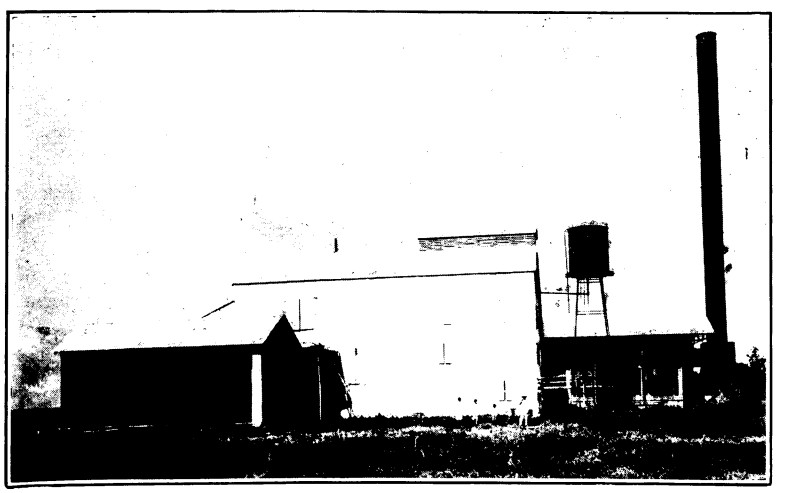
At San Carlos a 750-ton sugar central has recently been completed financed by American capital, the first to be constructed by foreign



E. de la Rama sugar central at Bago, Occidental Negros.

capital in this province, and probably the only one in the Islands that has so far proved a financial success. This plant, after two years' successful operation, is now being enlarged to nearly double its original capacity. The successful operation of this first central has demonstrated the adaptability of such organization, and already two more are assured, one by Government capital at Isabela and another by American financiers on the Yulo estates in Binalbagan. It is stated by competent authority that the district of Binalbagan alone is so rich that it can easily raise more sugar than is now being produced in the entire Philippine Islands, and the prediction is made with reason that ten years will see no less than 20 centrals in operation in Occidental Negros.

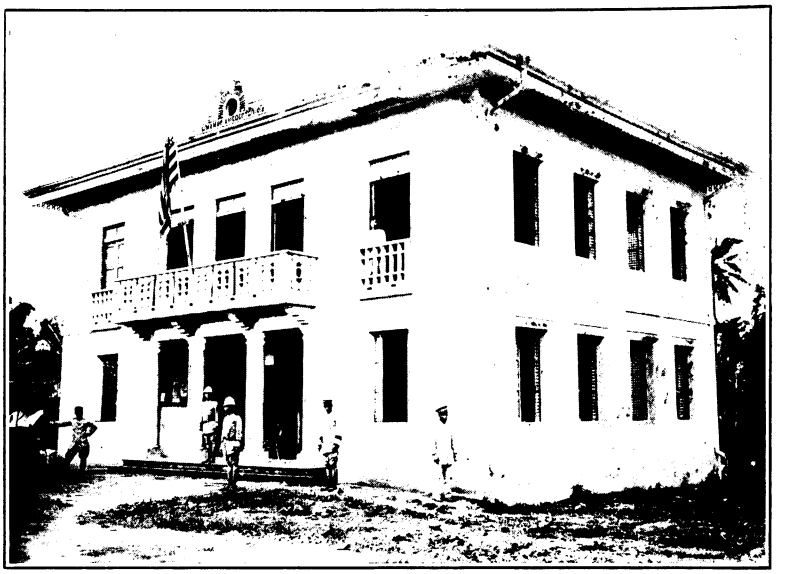
Besides these centrals there are in operation 6 centrifugal mills making 96° sugar, owned and financed by local capital. Two belong to the De la Rama estate, one to the Urquijo estate, one to Lizarraga



Guanko sugar central at Hinigaran, Occidental Negros.

Hermanos, one to Gomez Brothers, and one is owned and operated by Guanco in Isabela, near the site of the new Government central. All these mills have been successful, for centrifugal sugar is worth about ₱11 a picul as against an average price of ₱6 a picul for other grades. Moreover, the improved centrifugal mill extracts more than 90 per cent of the juice from the cane as against 60 per cent under the old system.

The central systems are operated under a contract with the planters by which the central association collects the cane and mills it, and takes from 40 to 50 per cent of the sugar extracted as payment. Most contracts run for fifty years, when the central reverts to the planters of the association. The *hacenderos*, of course, guarantee a certain amount of cane yearly. Individual planters in San Carlos are putting in irrigation systems and extending their planting. The company which is to erect a mill in Binalbagan also expects to irrigate the majority of the land in that district. As



Himamailan municipal building, Occidental Negros Province.
(Plans prepared by local architect.)

to profits accruing to the planter from a central system, he obtains approximately the same amount of sugar as formerly, but its value is nearly twice as great and he is saved the expense of milling the crop.

*Production statistics of Occidental Negros.*

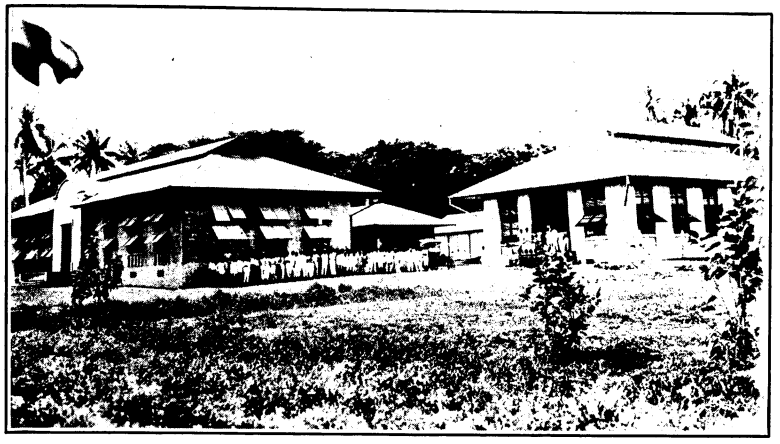
| Municipality. | Haciendas. | | Sugar-cane planted. | Estimated production of sugar 1915-16. | Actual production of sugar 1914-15. | Actual production 1914-1915. | |
|---|---|---|---|---|---|---|---|
| | Number. | Area. | | | | Palay. | Maiz. |
| | | | *Lacsas.* | *Piculs.* | *Piculs.* | *Cavans.* | *Cavans.* |
| Bacolod | 32 | 8,731 | 3,789 | 88,955 | 80,751 | 14,840 | 100 |
| Bago | 45 | 11,433 | 5,132 | 187,980 | 170,013 | 24,594 | 1,997 |
| Binalbagan | 18 | 3,342 | 2,105 | 72,300 | 59,546 | 2,790 | 455 |
| Cadiz | 52 | 9,162 | 6,261 | 166,530 | 119,556 | 2,103 | 2,175 |
| Cauayan | 4 | 2,170 | 215 | 8,500 | 9,975 | 1,200 | 1,100 |
| Escalante | 1 | 380 | | | | | 4,500 |
| Himamaylan | 21 | 2,270 | 2,105 | 72,525 | 76,112 | 5,805 | 1,217 |
| Hinigaran | 12 | 2,971 | 1,559 | 77,250 | 51,352 | 6,443 | 295 |
| Ilog | 11 | 1,267 | 2,923 | 75,900 | 63,700 | 155 | |
| Isabela | 33 | 4,596 | 4,587 | 165,400 | 142,797 | 8,108 | 2,300 |
| Kabankalan | 18 | 3,182 | 2,499 | 109,650 | 101,916 | 4,570 | 1,202 |
| La Carlota | 39 | 8,874 | 8,679 | 241,450 | 236,303 | 8,208 | 1,345 |
| Manapla | 30 | 4,008 | 3,495 | 84,260 | 73,950 | 3,020 | 995 |
| Murcia | 18 | 3,041 | 1,135 | 27,800 | 20,054 | 7,210 | 455 |
| Pontevedra | 22 | 7,637 | 4,707 | 121,100 | 108,961 | 9,687 | 2,935 |
| Sagay | 8 | 2,210 | 1,010 | 34,100 | 30,760 | 15 | 710 |
| San Carlos | 15 | 4,195 | 4,755 | 159,700 | 128,070 | | 1,910 |
| Saravia | 39 | 4,736 | 4,505 | 117,200 | 154,767 | 8,770 | 1,390 |
| Silay | 64 | 10,759 | 8,234 | 272,200 | 238,990 | 14,647 | 3,281 |
| Talisay | 47 | 8,112 | 5,460 | 129,100 | 133,635 | 15,178 | 1,067 |
| Valladolid | 8 | 870 | 730 | 19,320 | 17,260 | 2,050 | 30 |
| Victorias | 26 | 4,861 | 3,413 | 90,950 | 76,775 | 4,665 | 910 |
| Total | 563 | 109,307 | 77,298 | 2,322,170 | 2,095,243 | 142,058 | 30,369 |

NOTES.—An *hacienda* is a large plantation. One *lacsa* is 10,000 *puntas*, or stools, of sugar cane. One *picul* is 63.25 kilos. One *cavan* is 75 liters. *Palay* is unhulled rice. *Maiz* is Indian corn.

PORT WORKS.

Efforts have been made at various times to establish a port on the Island of Negros, and the generally accepted reason for not developing such port has been that there were no suitable locations. This is not the case, however. Two excellent harbors are available in the

province—one in the north, the Danao River at Escalante; and another in the south, the bay at Asia. Both of these are roomy, have deep water along the river banks, and are land-locked. However, both are too far away from production centers to be utilized, at least for the present. Several of the northern rivers would



Bacolod Trade School, Occidental Negros.

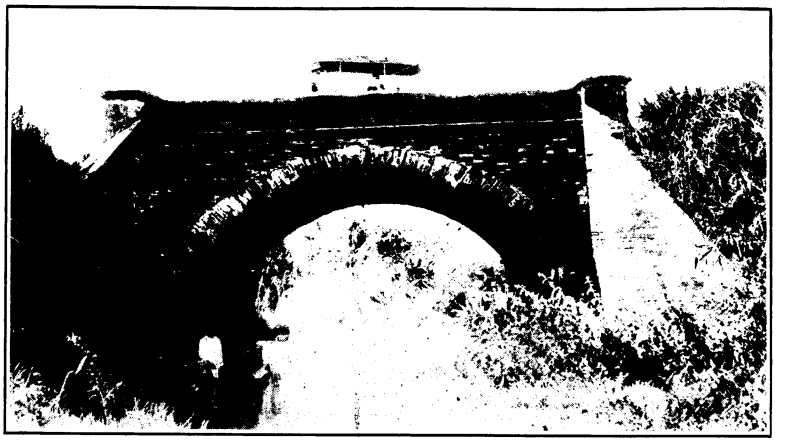
also make good harbors with a very little dredging. The Bago River south of Bacolod could be developed by means of jetties. Indeed, it is this very abundance of good harbors for sizable craft that will prevent any point on Negros from ever becoming an important export port. Iloilo, by natural location, is easier to reach by water from almost any place in Negros than is any other. Railroad transportation will always be more expensive than water transportation, and, as a consequence, the future of the Province of Occidental Negros lies in its agricultural development and not as a distributing or financial center. It is possible that in the course of time the plantations will be worked so far inland that a railroad near the foot of the mountains from Kabankalan to Escalante will pay dividends, but the writer is inclined to believe that the central systems soon to be established will care for all that, and that for many years the situation will remain the same as it is to-day.

ROADS.

In spite of the richness of the soil and the favorable climate, there is a dearth of population in the province, notwithstanding extensive immigration from neighboring islands. In the past, this has been largely due to the lack of transportation facilities, both internal and interprovincial.

Hinigaran Market, Occidental Negros.

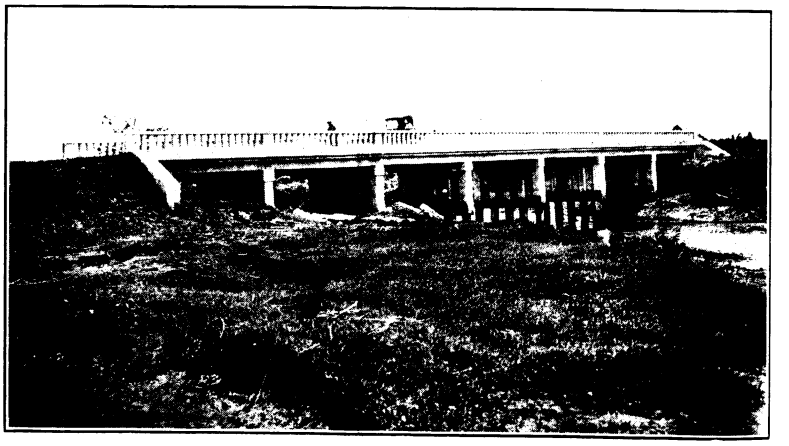
Especially is this the case on the northeast coast, from which the densely populated Island of Cebu can be reached in a parao by a few hours sail. Settlers are constantly coming in, but aside from the rivers there is as yet no means of transportation in that section, and consequently the chances to trade are limited. Many people are taking up homesteads at Cadiz and Fabrica in the districts where the forests have been worked over, and this increase of small individual holdings not only tends to increase the prosperity of the country, but probably creates a greater demand for roads than to the large



Spanish bridge on the La Carlota–Garanja Road, Occidental Negros Province.

concentrated estates owning tramway lines, private roads, sailing vessels, etc.

Negros Occidental was settled not over forty years ago by people from the neighboring Island of Panay, most of them being from Molo and Jaro in Iloilo. Until very recently the settlements were located exclusively on the banks of the numerous rivers and all communication was by boat. These large navigable rivers occur at intervals of 7 or 8 kilometers from Manapla in the north to Cauayan in the south, and have always furnished a cheap and ready means of transportation to the scanty population that existed along their banks. Furthermore, it was not necessary to maintain a state of military preparedness in Negros as in Luzon, and hence no military roads were necessary. The planters of Negros have been peaceful, as a rule, only wishing to be left alone to work and make and spend money. Iloilo was the governmental, military, financial, and religious center and was always easily reached in a few hours by boat from any place on the island. Many Negros people, therefore, lived mostly in Iloilo and Jaro and only spent a season on their *haciendas* each year. This is still largely the case, although better means of getting around allow them to travel back and forth more frequently. Many a prominent Negros planter keeps a house in Iloilo, with a staff of servants, automobiles, etc., ready for occupancy

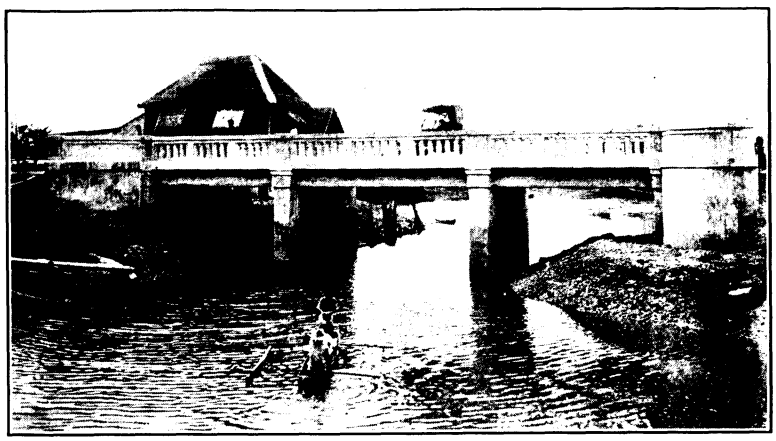


Severino Bridge, Occidental Negros Province.

whenever he may chance to arrive. For these reasons Negros, unlike most other provinces, has no Spanish public works except a very few small culverts, usually on *hacienda* roads, and, of course, the church and convent in each municipality and important barrio. The

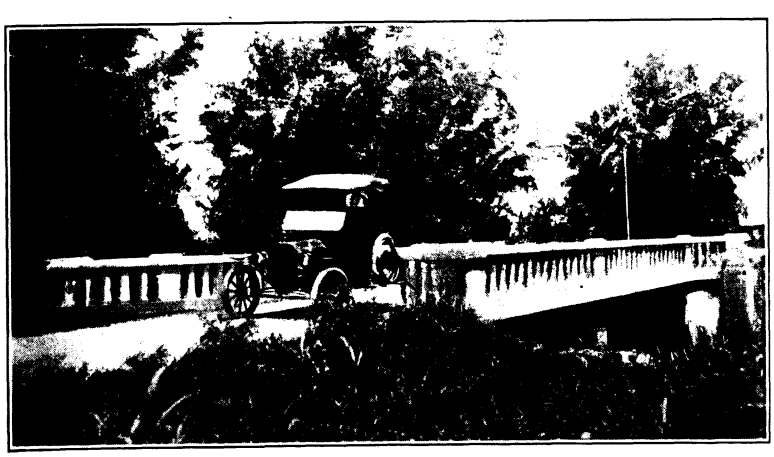
need simply did not exist and consequently no public works were attempted.

The new road-building program was started in 1908 and has been pushed steadily ever since. No other province in the Islands has so consistently voted the greatest proportion of its total income



Prize Bridge on the Bacolod–North Road, Occidental Negros Province.

to road and bridge construction projects. The road-construction problem in Negros Occidental hinges almost entirely on the administrative value and the convenience of such means of communication. The province consists essentially of a coastal plain averaging about 15 kilometers in width, divided, as aforesaid, by numerous rivers and bounded on the east by the mountainous backbone of the island. There are very few inhabitants in the southern portion below the *población* of Cauayan, and many of these are non-Christian. For many years to come, the produce will continue to go down the rivers and to Iloilo by lorcha, and the economic value of the road systems will be simply that of connecting production centers to these rivers. There is now under way the main trunk line from Kabankalan and Ilog to San Carlos, about 240 kilometers in length, connecting all the large agricultural districts with Bacolod, the capital. Of this 240 kilometers of main road, 178.5 kilometers are now in passable condition. Of these portions, 76 kilometers are declared as first class and 30 kilometers are second class, passable at all times with an automobile. The other 70.5 kilometers are graded and passable at most seasons, and portions are now being surfaced as rapidly as gravel can be obtained. The numerous rivers, however, make a trip from one end of Negros to the other quite tedious, there being 10 ferries

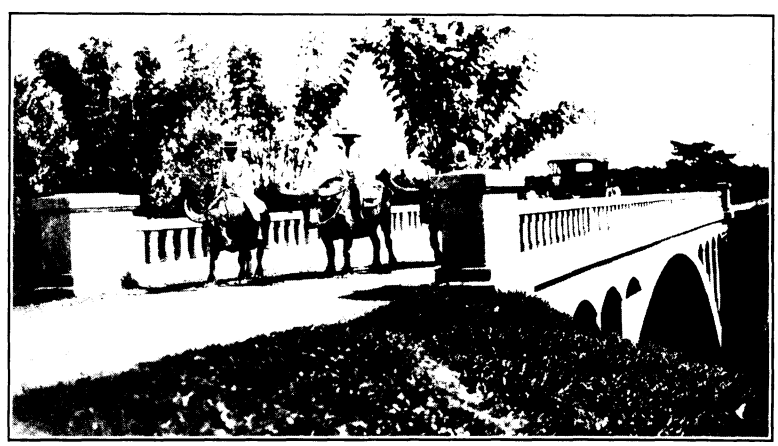


Lungaug Bridge on the Bacolod–Manapla Road, Occidental Negros Province.

or *balsas* between Bacolod and Ilog and 4 between Manapla and Sagay. All bridges on the first-class road from Bacolod north to Manapla are either built or under construction. South of Kabankalan and Ilog lies a vast wooded plain with a coast line of about 150 kilometers in the municipality of Cauayan, but it will be many years before this country is developed so as to need transportation facilities.

Another trunk line is proposed to run through the foothills back from the coast. This road would connect up the barrios of Eustaquio Lopez, Guimbalaoan, La Granada, Murcia, Maao, etc., and throw open to settlement and cultivation a large area that is now barren, due to lack of transportation. Such a road will come eventually, but for the present its economic value is doubtful.

The economic value and the justice of feeder roads—that is, roads leading inland from the coast road to *haciendas* located away from the river banks—is of such importance as to merit discussion. Funds now in sight will make possible the completion of 240 kilometers of first-class road by 1920. It is essential that the rich San Carlos section and the mills at Cadiz and Sagay be connected with Bacolod by road. The coastal plain on the San Carlos side is narrow and besides is well supplied with tramway and a railroad leading to the central, and in all the other municipalities the owners of *haciendas* have built private roads from their mills to the coast road for the transportation of their crops. Many others have formed companies and built tramway lines from the interior plantations to the river ports, and haul their sugar and other produce that way. Furthermore, it is possible that in the near future every locality will have its central and hence its railroads, thus making the highway system of Negros largely a matter of convenience in commerce and



Magsungay Bridge, No. 2.5, on the Bacolod–South Road, Occidental Negros Province.

administration rather than one of industrial value, since the staple crop is and always will be sugar. However, there are interior localities which need outlets by road. A number of these roads have been built already for 109 kilometers in all. Of this, 51 kilometers are declared first class and the rest is passable at most times.

Road construction costs are very high on account of the numerous large rivers to be bridged and the still more numerous creeks and other small streams. For instance, in the new road under construction from Victorias to Manapla, a distance of 9 kilometers, there are three 13-meter arches and 20 culverts, besides numerous pipe drains. Many of the rivers are navigable and the bridges will require draw spans to allow the passage of lorchas and an occasional tugboat. Gravel is not plentiful, and is in general of very poor quality. So far no good rock for quarry purposes has been discovered in a convenient location. Only one small crusher is working on boulders obtained from the Bago River, but it is possible that a quarry can be located on the near-by Island of Guimaras and rock distributed from there to convenient points along the coast road. The feeder roads leading inland, however, will always have to depend on the very inferior river gravel.

The province maintains 128.2 kilometers of first-class road at present, and by January 1, 1916, the construction now in progress will bring that amount up to 150. Besides this there are 30 or 40 kilometers of shell road which are in general equal to or better than most gravel thoroughfares, although maintained as second class. Maintenance costs on shell roads are very small, one caminero to each

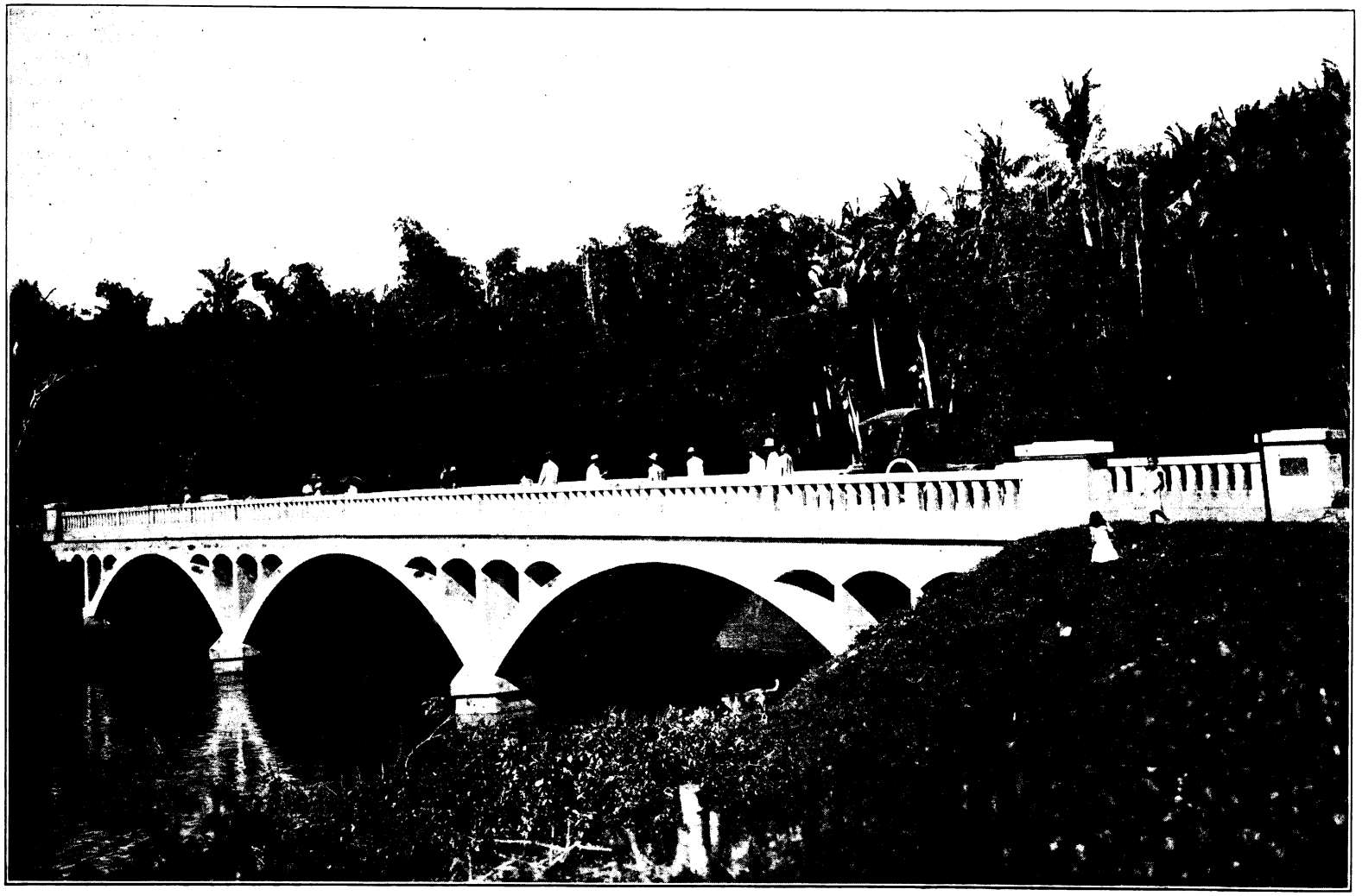
2 kilometers being sufficient. In the wet season these roads practically maintain themselves, for, if all the pools of water are kept drained and the berms well kept, the shell highways make automobile speedways the equal of any. The province has in all 290 kilometers of highway that is passable at most times of the year.

All first-class roads in the province so far have been surfaced with river gravel, except the 14 kilometers of the Bago-Maao Road which are built of crushed boulders from the Bago River. So far these gravel roads have stood the heavy automobile traffic very well, but auto trucks are now gradually being brought into use and have already demonstrated that a better road material must be used very soon, and also that a thicker course of metalling will be necessary. No doubt the time will come when regular concrete pavements will be a necessity in certain sections of the province, or possibly the present gravel surfacing can be utilized as a sort of Telford base upon which a broken stone and asphaltic or bituminized pavement may be built. All roads in the province have been well built with well-rolled subgrade and carefully coursed gravel, and it has been customary to let all grades lie over one rainy season in order to get the benefit of the compacting effect of the rains. These precautions have resulted in a very firm subgrade and one that will hold up almost any traffic.

*Traffic census.*

| | Bacolod-South Road. | | Bacolod-North Road. | |
|---|---|---|---|---|
| | Kilometer 20. | Kilometer 27. | Kilometer 10. | Kilometer 23. |
| Days' count | 30 | 32 | 32 | 31 |
| Automobiles | 395 | 676 | 1,806 | 1,072 |
| Motorcycles | 98 | 114 | 205 | 73 |
| Bicycles | 632 | 709 | 1,097 | 538 |
| Carts | 121 | 1,170 | 1,271 | 402 |
| Quileces | 79 | 184 | 903 | 290 |
| Pedestrians | 6,895 | 10,915 | 9,461 | 6,204 |

The Bacolod–North Road between Bacolod and Silay, is probably the most generally used auto thoroughfare in the Islands outside of the roads adjacent to Manila. It is to be remembered in this connection that July is the one month of the year when nearly all traffic is suspended as it is after the sugar season, no crops are moving, and most of the *hacenderos* are either spending their time in Iloilo or Manila or traveling in Europe. In the months of October, November, and December, the cart traffic is trebled or quadrupled by reason of hauling sugar to the various river ports.



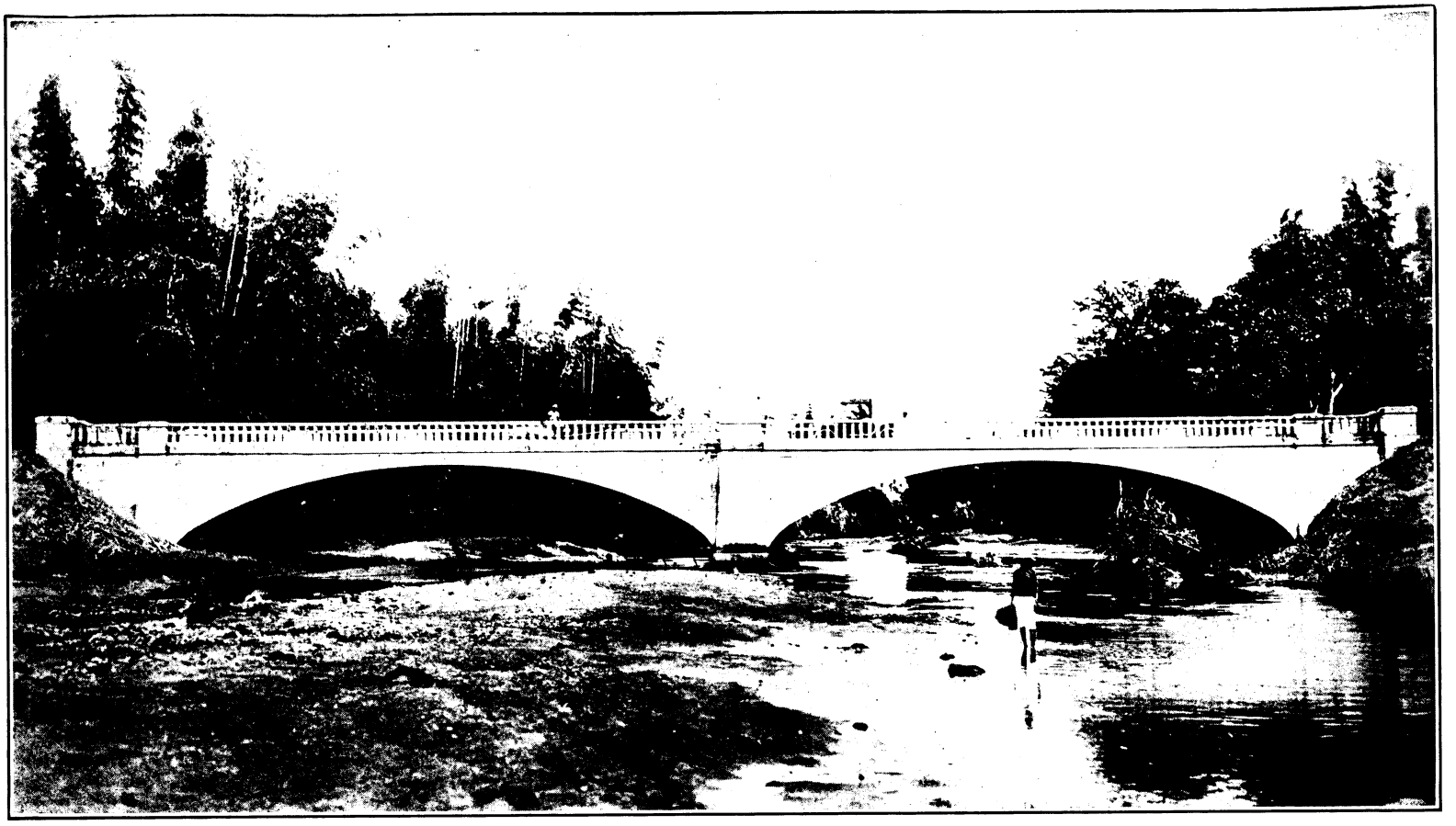
Lupit Bridge on the Bacolod–South Road, Occidental Negros Province.

Occidental Negros is to-day the possessor of more automobiles than any other province in the Islands. The planters are great travelers and may be met with all over the province, usually going to one or another of their *haciendas*. Many families own land in several municipalities and for this reason are always traveling from one part of the province to another. Every farmer has at least one auto.

A traffic census taken in July showed the following traffic on the provincial roads taken at representative locations:

BRIDGES.

Occidental Negros was rather fortunate this year in receiving a special Insular allotment of ₱75,000 for roads and bridges, an Insular loan of ₱55,000 for the Bagacay Bridge over the Binalbagan River at Isabela, and the regular allotment of ₱64,500, making a total of ₱194,500 Insular money available for road and bridge construction. This, together with the liberal policy of the provincial board toward public works and the unexpended balances left from 1914, made a



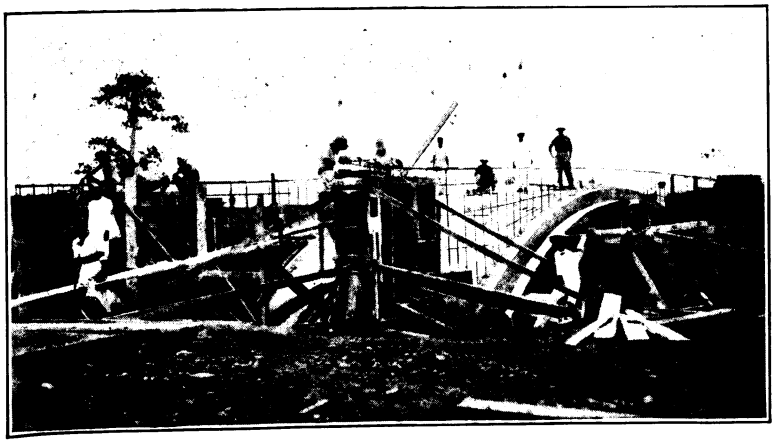
Matabang Bridge, Occidental Negros Province.

total of nearly ₱600,000 to be expended on public works in 1915. Of this sum all but ₱50,000 will be expended before January 1, 1916.

During the year 1915 the province has constructed the Prize Bridge, a 3-span reinforced-concrete pile bridge consisting of two 6-meter and one 7-meter spans and costing ₱11,670; the Malugo Bridge, a 97-meter collapsible-deck bridge, at a cost of ₱8,000; three reinforced-concrete pile bridges, one of two, another of three, and a third of seven, 7-meter spans, at a total cost of ₱43,675. There are now nearing completion three 13-meter reinforced-concrete arch bridges and 20 culverts which are costing ₱54,000. This is a total bridge expenditure already for the year of ₱117,345. Bids are now being requested for a bridge over the Pontevedra River at an estimated cost of ₱26,000 and for the Bagacay Bridge, estimated cost ₱65,000, making a total bridge program for 1915 of ₱210,000, in round figures. Unfortunately, however, this is only a small beginning upon the project of bridging all the rivers on the main trunk roads of the province. No less than 14 bridges yet remain to be built, with spans varying from 100 to 300 meters, nearly all of which will require draw spans for the purpose of maintaining navigation.

Economically, the Province of Occidental Negros could well afford to borrow from ₱2,000,000 to ₱3,000,000 for road and bridge construction, for the taxes from land which would be opened up to cultivation by such an expenditure would in a very few years repay the loan, both interest and principal. In 1914–15 the province produced 2,100,000 piculs of sugar at an average value of ₱6 a picul, 142,000 cavanes of *palay*, and 30,000 cavanes of corn. These amounts are being increased from year to year, the 1915–16 crop predictions being about 20 per cent in excess of the above. Better transportation facilities are not so much needed for the crops themselves as for labor and supplies and to encourage immigration. This entrance of settlers from other parts of the Islands is steadily increasing the cultivated area and giving a consequent increase in the revenues.

Bridges in the province are in general of the slab-and-girder type and in the south especially are founded on pile foundations. There



Manapla Bridge under construction, Occidental Negros Province.

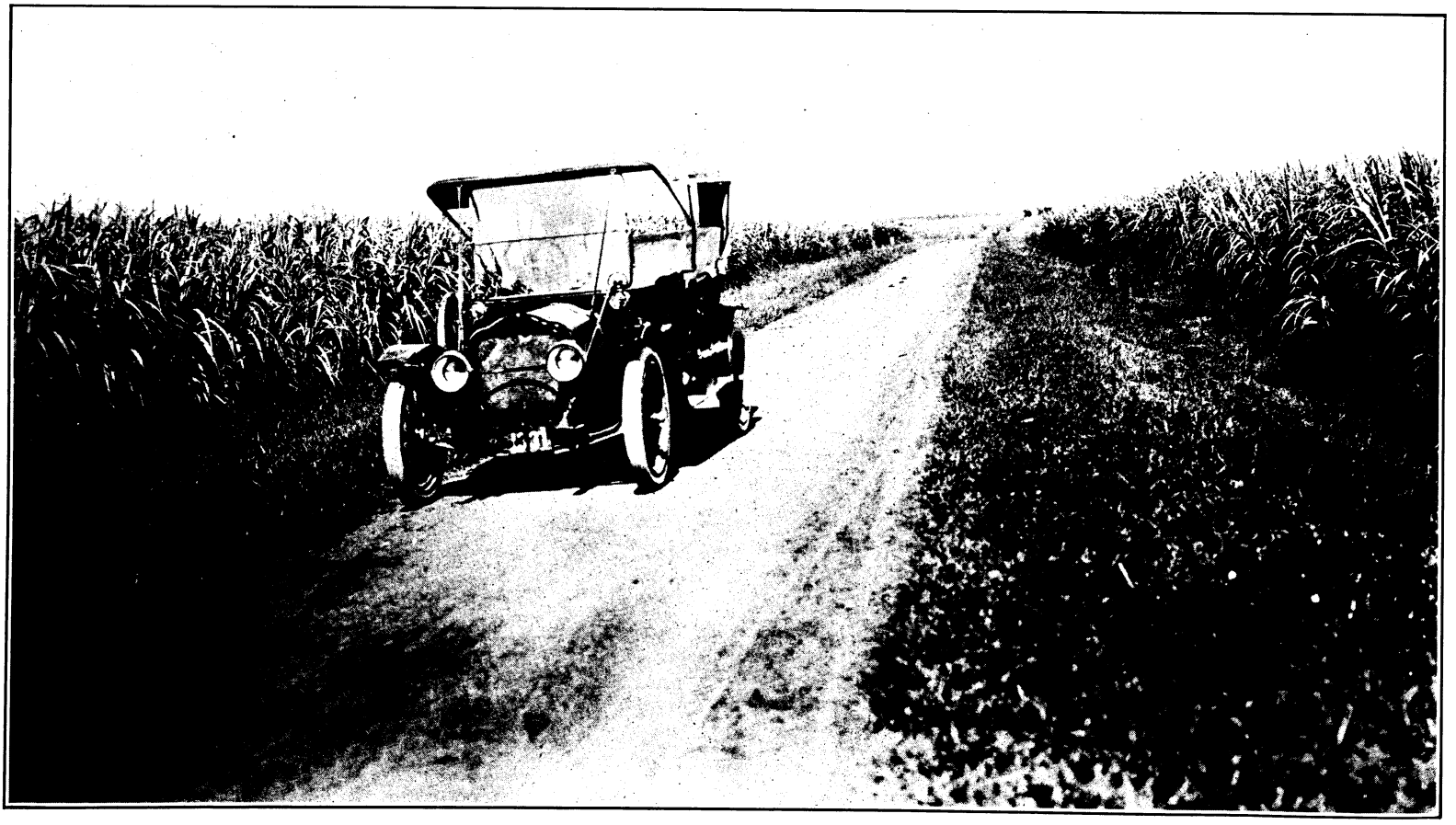
Plaza at Silay, Occidental Negros.

Malago collapsible bridge on the Victoria–Manapla Road, Occidental Negros Province.

are six or seven arches besides the ones now building. These also generally have pile foundations, but the three now in process of construction are built without piles, being founded on *baquias*, a kind of sand-clay rock, which when saturated is exceedingly hard, but which soon crumbles when exposed to the air. It usually lies in layers of 40 to 60 feet in thickness, and when encountered in pile driving is the bane of the contractor's life. In excavation it has to be removed with dynamite, like hard rock. However, it makes a good foundation, and the engineer who has a structure so founded need have no worries regarding his footings.

BUILDINGS AND OTHER PUBLIC WORKS.

There are now three modern markets in the province, at La Carlota, Hinigaran, and San Carlos. Markets in Maao, a barrio of Bago,

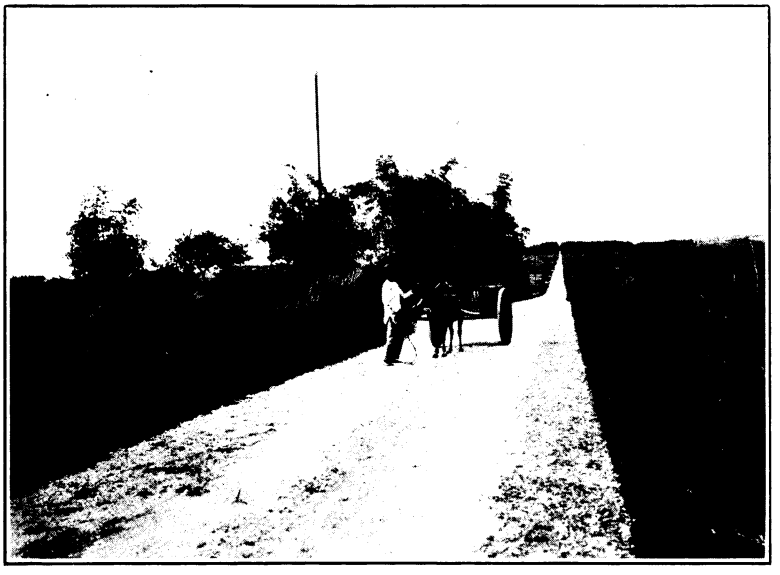


Kilometer 10 on the Hinigaran–Isabela Road, Occidental Negros Province.

and Bacolod are already arranged for and will be built before the end of this year. Cadiz, Silay, and Saravia also contemplate such structures. These modern markets have proved wonderfully successful both from a health and from a financial standpoint. As revenue producers they are in all cases paying better than was expected, collections being more than enough to pay all interest charges and maintain the sinking funds. The San Carlos market, especially, a 24 by 42.8 meter type "B" structure, has increased the collections greatly beyond all predictions, although it has only been in operation about three months.

There is only one concrete municipal building in the province, that at Himalayan. It was erected by Sr. Agustin Ramos, a wealthy planter of the municipality, at a cost of about ₱18,000 and presented by him to the town. Plans are now being prepared for a ₱25,000 structure for the municipality of Bago, which will be built from loan funds under the administration of the Bureau. Civic pride is being awakened in all the municipalities and many other beautiful and appropriate municipal buildings are to follow.

The province is well provided with schools, nearly all the municipalities having new concrete standard buildings. The provincial group in Bacolod consists of a frame high school, a domestic science school, and the two trade school buildings, all of concrete. Funds are now available for a part and loans for the remainder are in



Kilometer 46 on the Bacolod-South Road, Occidental Negros Province.

prospect for seven more buildings, most of them to be built by standard plan No. 6.

Other public works in the province are artesian wells, cadastral surveys, etc. Wells have already been driven in many of the municipalities, and two rigs are now at work driving new ones as fast as possible, one in the north at Sagay and the other at Pontevedra on the Bacolod–South Road. Only a few failures have occurred, in most cases they encounter plenty of good clear water at from 125 to 300 feet. Most wells have to be pumped, but quite often one is drilled that flows from 5 to 15 gallons per minute. The province guarantees one-third of the cost of all wells in a municipality when such municipality makes an appropriation and asks for a well rig. The district engineer has little to do with the personnel of the well division, further than to take care that funds are available before a well is started, and to requisition supplies. An occasional inspection is made, in most localities once or twice a month.

For several years a large party of surveyors have been operating in the province on cadastral work, and such progress has been made that all municipalities from Victorias in the north to Hinigaran and Isabela in the south, 12 in all, are now completely surveyed, and title has been decreed in several of them. As a result, there are 132 Agricultural Bank loans in the province, with a total of ₱2,106,450, or an average of ₱15,800 per loan. These loans will be increased yearly and the consequent increase of production and of cultivated areas will render still more insistent the present demand for road extensions and other public works.

There are a number of private homes which deserve mention. The house of the Yulo family in Binalbagan and of Aniceto Lacson in Talisay are both fine examples of Spanish architecture and would attract attention anywhere. The lavish hospitality of all the Negros planters is proverbial, and the table is always set for a number of guests. Don Aniceto Lacson has entertained nearly every celebrity who has ever visited Negros and has seated as many as 350 guests in his spacious dining hall.

All public works are popular in Occidental Negros, right of way troubles are few, and donations of cash for improvements are the rule, as for example the guaranty by the *haciendas* of Isabela of a donation of ₱11,000 to aid in the construction of the Bagacay Bridge. Planters of Maao and Bago have proposed to collect ₱7,000 for the Maragandang Bridge, a ₱30,000 project, if the province will do the rest. This spirit is general throughout the province and "pork-barrel" projects are entirely absent, public sentiment being rather to get together and get the most done for the money, and also where it will do the most good. The writer knows of no road or other structure in the province that is not amply justified by traffic and use. The location and character of public works here speak volumes for the ability and foresight of the various provincial boards and of the various engineers who have been responsible for them.

## A METHOD OF PREPARING TABLES OF END AREAS FOR EARTHWORK.

By E. C. Brown, District Engineer.

In preparing estimates of the amount of earthwork required for the construction of roads and canals, the quantities are usually calculated from the center cut or fill. Where the estimates involve any considerable amount, it is more economical to prepare a table of end areas for center heights varying from 0.0 to the greatest height required by the work. An easy and quick method of preparing such tables may be demonstrated by the computation of a portion of a table of end areas for a prism with a 9-meter base and $1\frac{1}{2}:1$ side slopes, as follows:

*Table of end areas level sections.*

| 9-meter base. | Side slopes $1\frac{1}{2}:1$. | | |
|---|---|---|---|
| Center cut or fill. | Area of section. | First difference. | Second difference. |
| 0.00 | 0.0000 | | |
| .02 | .1806 | .1806 | 0.0012 |
| .04 | .3624 | .1818 | .0012 |
| .06 | .5454 | .1830 | .0012 |
| .08 | .7296 | .1842 | |
| | .1854 | | |
| .10 | .9150 | | |
| | .1866 | | |
| .12 | 1.1016 | | |
| | .1878 | | |
| .14 | 1.2894 | | |
| | .1890 | | |
| .16 | 1.4784 | | |
| | .1902 | | |
| .18 | 1.6686 | | |
| | .1914 | | |
| .20 | 1.8600 | | |

As will be noted, each succeeding area is obtained by adding a certain quantity to the area previously obtained. In order to determine this quantity to be added, it is necessary to calculate, in the usual way, the first three areas. The difference between the area for a height of 0.0 and the area for a height of 0.02 is 0.1806, which is the quantity to be added to the area for a height of 0.0 to obtain the area for a height of 0.02. The difference between the area for a height of 0.02 and the area for a height of 0.04 is 0.1818, which is the quantity to be added to the area for a height of 0.02 to obtain the area for a height of 0.04. The quantity to be added has then increased by 0.0012. Therefore, the quantity to be added increases

each time by 0.0012. The calculation of the remainder of the table then resolves itself into simple addition, though an area should be checked at intervals in order to prevent carrying a mistake through the entire work. The accuracy of the entire table may then be determined by merely checking the last area obtained.

This method may be employed in calculating any table where there is only one variable involved, and where the result is represented by an equation of the second degree. In the above example the equation is $A=3/2h^2\div gh$ where $A$ is the area of the section and $h$ the height of the cut or fill.

## HYDRAULIC RAMS.

By L. W. SCHEIDEMANTEL, District Engineer.

The first introduction of hydraulic rams into Bukidnon Province was made by ex-Governor Frederick Lewis and Mr. Richard Barton in 1909, the idea having been obtained from the "Frontiersman's Bible," a Montgomery-Ward catalogue. The first installation was successful and produced an emphatic demand for more, so that Montgomery-Ward became a large factor in the civilizing of a primitive people. These installations, made in a primitive country by a primitive people, are fully as well done as any made by their more prosperous and better educated neighbors.

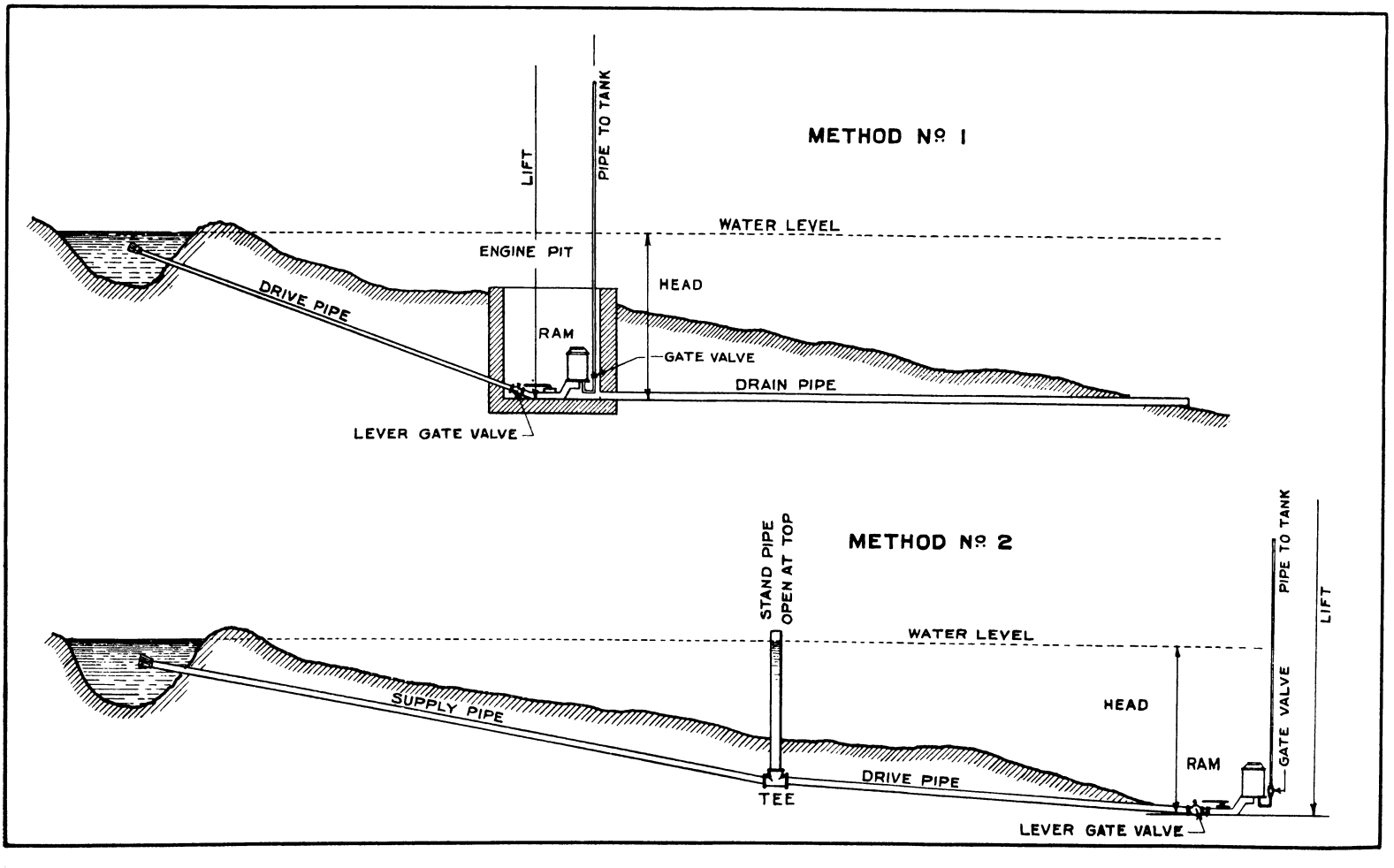
Rife rams are now supplying water to all the principal industries and villages in Bukidnon Province. A typical installation is that made by the Philippine Development Company at Diklom in 1914. This ram supplies water for an average of 200 people, 200 head of cattle and draft animals, and for the irrigation of a 2-acre truck garden. The supply comes from a mountain brook through a diversion ditch and is impounded in a concrete settling basin of 200 gallons capacity. The basin is covered with wire netting to protect the water from contamination by birds and animals.

A 2-inch supply pipe, 55 meters long, leads from the basin to the ram, the difference in elevation being 6 meters. The ram is set in concrete. Delivery is through a 1-inch pipe about 65 meters long and against a head of 50 meters, into 500-gallon galvanized-iron tank set on a wooden tower on the plain above the ram. The elevation of the tank gives excellent pressure for 20 family hydrants, a number of flush closets, 3 public hydrants, and 2 watering troughs for cattle.

Battery of hydraulic rams lifting water 250 feet with 12-foot head, on plantation of Behn, Meyer & Co. at Isabela, Basilan Island, Zamboanga Province.

The sketch shows two methods of securing the necessary fall for the working of Rife hydraulic engines. The minimum delivery of this ram is calculated by the following formula:

$$Q=\frac{960\ GF}{L}$$



Rife ram operating on the rancheria of Amai Karut (Moro), deputy governor of Lanao Province. The automatic water waste.

in which,

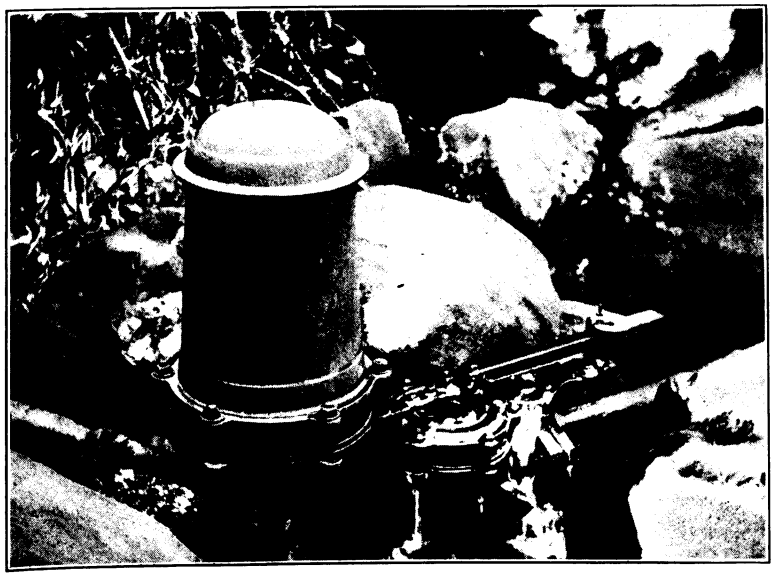
$Q$=gallons per day delivered.
$G$=gallons per minute available for supply.
$F$=fall of supply pipe in feet.
$L$=lift in feet.

Among the other installations in the province may be mentioned the one by Amai Karut, deputy governor of Lanao Province, on his rancheria. It supplies water for irrigation as well as for domestic purposes and was the first installation to be made by a Moro. Behn, Meyer & Co. have a battery of three rams working on their plantation at Isabela, Basilan Island—one Niagara, one Rumsey, and the third a Rife. The American colony at Momungan, Lanao Province, is about to install a Gould No. 8, having a 4-inch drive and 2-inch delivery.

At Pantar, Lanao Province, on the Overton–Camp Keithley Road, a No. 7 Rumsey ram has been installed by the military authorities for the purpose of supplying water to the troops at that point. The 4-inch drive pipe is 140 feet long with a head of 35 feet, and delivery is through a 2-inch pipe 1,000 feet long, against a head of 295 feet. The quantity delivered is 600 gallons per hour, but it is claimed that this can be doubled by using lumbayao washers on the valve.

The No. 20 Rife ram operating at Malaybalay lifts the water 300 feet, the one at Maluko 200 feet, and the one at Tangculan 600 feet.

These rams all require more or less intelligent attention, and this fact, coupled with the enormous waste of water incident to their use, usually renders a gravity system preferable, even at a much greater first cost.



Rife ram operating on the rancheria of Amai Karut (Moro), deputy governor of Lanao Province. The automatic valve at rest.

## METHOD OF MAKING MANGANESE OXIDE BLACKBOARDS ON CONCRETE WALLS.

By J. R. BARRY, District Engineer, Laguna Province.

1. As soon as possible after the forms are removed, the concrete surface is roughened with stone picks, or chisels and hammers.

2. Then manganese oxide plaster, approximately ¼ inch thick, is spread upon the roughened surface, which was previously wetted. This plaster is prepared as follows:

1 part by measure of pure manganese oxide.
15 parts by measure of cement (cement measured loose).
30 part by measure of clean sand.

The manganese oxide is mixed first with the cement, after which the dry sand is added, and then after the dry mass has been well mixed a mortar is made by the addition of water. In placing the mortar it is troweled until it begins to set.

3. Immediately after the above has been accomplished, a surface coat of 1 part oxide and 2 parts pure cement is applied and troweled to a hard smooth surface. Good troweling must be done to secure satisfactory results.

4. After the board has dried, it should be rubbed down with an old sack or any old cloth available, and finally washed to remove any unfixed coloring matter. Should rough spots show up they may be removed by the use of fine emery paper.

The chalk rail and top strip may be applied either by the use of inset molave blocks or expansion shields and screws.

The amount of oxide in the plaster coat may be varied somewhat from the proportions given according to the quality of the oxide, the exact proportions necessary being determined by experiment.

The oxide cost approximately 21 centavos per kilo in 1914 and comes in 100-kilo kegs.

## ON THE JOB HERE AND THERE.

Mr. W. L. Gorton, former chief irrigation engineer of this Bureau, is now with his former employers in the States, Messrs. J. G. White & Co., of New York. Mr. Gorton is at present on one of the firm's projects in Idaho.

Mr. C. W. Hubbell, former chief engineer of this Bureau, is now with the city of Detroit in a consulting capacity on water supply. In connection with his work he has recently visited a number of the large plants in the country, including Rochester, Albany, Boston, New York, Washington, Baltimore, Atlanta, Columbus, Chicago, and Milwaukee.

## PROJECT NOTES BY DISTRICT ENGINEERS.

### ALBAY.

The construction of bridge No. 42.1 on the Polangui–Libon Road, Mr. M. E. Martin, contractor, is progressing satisfactorily in spite of the fact that the work is being done during the rainy season. Both abutments are now complete.

Concrete market tables have been placed in the Oas market. These tables are without doubt a great improvement, both in sanitation and utility. It would seem that a market without tables should no more be considered complete than a market without half of the concrete floor.

A standard plan No. 3 school building has just been completed on the Island of Rapu-Rapu at a cost of aproximately ₱7,940. Transportation and labor difficulties and little supervision all contributed to the high cost. Construction has been begun on a plan No. 6 in Calolbon and a plan No. 3 in Manito under conditions similar to those in Rapu-Rapu.

Funds have recently been made available for the construction of a plan No. 7 school building in Bacacay.

During the present rainy season many of the young trees recently set out along the roads in the lowlands have died and the leaves on

Handrail, 6-meter arch bridge No. 9.4, Guinobatan–Jovellar Road, Albay Province.

many others have turned yellow. A small hill was thrown up for each tree at the time of setting out, but apparently a considerable grade is necessary to prevent the tree from drowning out.

Handrail of Bridge No. 12.7, Guinobatan–Jovellar Road, Albay Province.

All bridges are now complete on the Guinobatan–Jovellar Road, except the 120-foot steel span across the Cabraran River, the abutments of which are now being placed for it. Much admiration has been expressed for the three-arch bridges on this road.

## AMBOS CAMARINES.

During the construction of the Pandan Road in North Camarines in November, 1914, it was extremely difficult to contract for the delivery of stone at ₱3 per cubic meter, with an average haul of 6 kilometers. When the Daet–Mercedes Road was constructed, three months later, the hauling was contracted at 60 centavos per cubic meter for the first kilometer, with 10 centavos per cubic meter advance for each additional half kilometer of haul; and 100 carts daily were secured. Recently, or nine months after the first hauling was contracted, stone has been obtained, with same length of haul as the Pandan Road required, for ₱1.50 per cubic meter, drivers in all cases loading their own carts.

The dry season and the low price of abacá were important factors in reducing the cost of hauling, but the most important condition was that of actually educating the owners and drivers of the carabaos as to what could be accomplished. The prices established by this work had the same effect on the prices of all articles transported.

The repair gang is working on the Pauili–Baao section of the Naga–Boundary Road. This section has a gumbo subgrade and the extremely heavy truck traffic during the past quarter rutted the road in many places. It is planned to resurface these kilometers the early part of next year.

Work has been started on the Buhi presidencia. This is a 2-story 9 by 15 meters reinforced-concrete building.

Constant rains and an epidemic of malarial fever have delayed work on the Pili–Tigaon Road. Seven kilometers of subgrade and the culverts on kilometers 1 and 2 have been completed. Four kilometers of tram track were laid to transport surfacing and materials for concrete. About 150 men are employed.

The Nabua market, standard type "B" 21 by 43.5 meters, was completed and accepted September 1. This is the first market of this type constructed in the province. Cost, according to B. P. W. Form No. 251:

| | |
|---|---|
| Site | ₱4,018.70 |
| Grading | 500.00 |
| Materials | 10,821.25 |
| Labor | 2,951.39 |
| Transportation | 610.00 |
| Surcharge | 961.79 |
| Total expenditures | 19,863.13 |

One kilometer of first-class road has been constructed in the municipality of Calabanga.

The Daet Central School, standard plan No. 7, was completed and formally inaugurated on August 13th. This is the first concrete building in north Camarines.

The Iriga Central School, plan No. 10, is under roof. Work is progressing rapidly and the building will be completed by October 15.

The Salvacion School, plan No. 2, was completed and occupied October 1.

Materials have been ordered for the construction of a standard plan No. 4 school building at Pamplona.

The Daet–Mercedes Road was opened for traffic August 24. Cost of the project, ₱50,000. The road roller is now working on the Daet–Indan and Daet–San Vicente ends of this road.

The municipal council of Caramoan have appropriated ₱3,500 for the construction of a second-class road from Caramoan to Bical. This road is an important outlet for the municipality, which during the past two years has appropriated ₱7,000 for municipal road construction under the supervission of the district engineer.

During the Spanish occupation the Naga–Pasacao Road was open for carromatas. Pasacao was a port of some importance, boats making regular stops, and passengers being able to embark for Manila. Since the opening of the Naga–Legaspi Road, and the repeated failure of crops in the vicinity of Pasacao, the port has become of so little importance that boats rarely stop. The sections of road from Naga to Milaor and from Pamplona to Pasacao are in fair repair and under regular maintenance, but the section from Milaor to Pamplona is hardly passable. However, an effort is being made to open this road for carromatas and light automobiles, so that persons going to Manila could embark at Pasacao, avoid the San Bernardino Strait, and arrive in Manila twenty hours after embarking.

Until 1914, the Pamplona–Pasacao Road was maintained by an intermittent gang working one or two months of the dry season, cutting the grass, filling the ruts, and repairing the road in general, the annual cost being about ₱1,000. In 1914 this road was put under continuous maintenance, at the same total expenditure per annum. By the first method the road was in a bad condition at the end of the rainy season, but under continuous maintenance the road came through in good condition, actually showing a general improvement throughout.

## ANTIQUE.

The construction gang on the North Road is now at kilometer 31. Work in this section is rather slow on account of bad weather and the rough nature of the country, which involves heavy cuts and high fills. Surfacing materials are spread ready for rolling at kilometer 29. Rolling is slow on account of bad weather and poor means of transporting coal from San José.

On the San José–Dao Road subgrade work was stopped at kilometer 21, where the new road joins the old Spanish road. The rest of the money for this project is being employed in constructing wooden culverts, which when completed will make vehicular traffic between San Jose and Dao both possible and comfortable.

The Pandan–Capiz Boundary Road is now for the first time opened for cart traffic. The total length of this road from Pandan to the Antique–Capiz boundary is 7.66 kilometers. One kilometer of the road from Pandan is fairly substantial, but on account of neglect the remaining 6.66 kilometers was in a very bad condition. This was reconstructed at the average cost of ₱530 per kilometer, with temporary wooden bridges and culverts. Approved cross-section is maintained throughout the lowland section, except in the hilly parts

and in other difficult places. The cheap cost of construction was due to a great number of mountain boys who were employed at 30 centavos per day and who turned out just as good as the older men.

Seventy per cent of the Culasi Central School was completed by September 10. The contractor, Mr. Adams, had to order some galvanized-iron roofing through the Bureau of Supply on account of lack of this material outside.

The construction of Buñgol Bridge at Culasi is progressing fairly well in spite of difficulties. Temporary piles have all been driven, all the 8 and 9 meter piles are cast, and two abutment piles are driven. Some form lumber for this bridge it still in San José and some of the other materials are in Iloilo, since no transportation can be had on account of bad weather.

All work on second-class roads is confined to the reconstruction of the wood and bamboo bridges and culverts which were washed away during the heavy rains of July. An effort is being made to cut through the point of Bacat Daraga at kilometer 53 on the North Road. This promontory is about 60 meters high and extends out into the beach. The material composing the point is a conglomerate cemented together in a peculiar way and at first sight is easily mistaken for concrete. It does not ring under a hammer, but is very hard to pick. Dynamite and powder are being employed.

Tree planting along first and second class roads is being continued right along. In some localities certain kinds of trees will not grow. These are replaced by other kinds.

A survey of the Antique–Iloilo Interprovincial Road on the Antique side is not being made. The old Spanish road which connected Antique and Iloilo was originally a good road and carriages used to travel between San Joaquin and Antique, but to-day the road is in a poor condition due to neglect. The old road starts from kilometer 12 at Guintas on the San José–Dao Road and is about 8 kilometers long to the boundary. A new line will be tried, to start from kilometer 14 of the San José–Dao Road which will shorten the line somewhat and avoid two rivers.

Other road projects for the coming year are Antique–Egaña Road (5 kilometers), San Pedro–Sibalom Road (8 kilometers), and Sibalom–San Remigio Diversion Road (4 kilometers).

Heretofore the provincial and Insular officials of Antique Province had their offices in the municipal building of San José. Lately, however, the province acquired this building for its own exclusive use. Plans for improving said building are now being made and the fund available is ₱5,000.

The municipality of San José acquired ₱15,000 from the province in return for the building and ground above mentioned. The council at first thought of either renting or buying a house for the present, but a new building is now contemplated, to be constructed from standard plans of the Bureau of Public Works. The question is now in the hands of the council.

The market site for Sibalom (11,360 square meters) has already been purchased at a cost of ₱430.08. The sum of ₱18,000 is now available for the construction of a 21 by 36 meter type "A" market. The municipal council has already authorized the advertisement for bids for this project.

San José also expects to construct a 21 by 36 meter market. The sum of ₱12,000 is now available. The provincial treasurer is working hard to obtain the site selected, some of the owners not being willing to give up their land.

The district engineer is now in charge of the work on the improvement of the San José Plaza, also of the work on the Rizal Monument, the money for the latter having been obtained partly by public subscription and partly through the sale of tickets in a beauty contest.

## BATAAN.

Surfacing has been brought to kilometer 6 of the Balanga–Orion Road, and broken stone to cover a 500-meter gap is piled along the road ready for spreading.

Due to shortage of funds, the balance remaining for the Orion–Limay Road will be used in the construction of a third-class road only.

The annex to the Provincial High School at Orani was completed during the early part of September, thereby giving an extra 72 square meters of floor space for classroom purposes.

All the houses within the proposed market site at Orani have already been removed from the site and construction will probably be started shortly.

The sums of ₱7,600 from local funds and ₱15,000 from Insular funds have been made available for the construction of a Bureau of Education standard revised plan No. 10 at Orani, and bids are shortly to be advertised for.

## BATANGAS.

About the 1st of April this year, a special allotment of ₱25,000 was received for the construction of the Lemery–Calaca Road. With this amount a little over 6 kilometers were constructed, or at a cost of ₱4,000 per kilometer. The construction was a standard 7-meter roadbed with 4 meters of broken stone surfacing 15 centimeters thick. This section has the record in this province of being the cheapest constructed road in the province. There remain 8.8 kilometers to be constructed in this section. At the same time an equal allotment was received on the Tuy–Nasugbu Road, which enable the completion of all the road except the approaches to three bridges for which funds are available and the bridges under construction. The approaches will be constructed when the bridges are finished. The completion of these three bridges, their approaches, and the 8.8 kilometers mentioned above will give a continuous first-class road from Batangas to the China Sea, a distance of 74 kilometers.

Work on the Batangas–Rosario Road progressed very well until about August 15 when work had to be practically suspended on account of the rainy season. There remain 2.5 kilometers to construct, for which funds are available, and should the rainy season not continue too long the project will be completed before the end of the year.

Estimates have been made on the Lipa–Rosario and Lipa–Luta Roads, 12.5 and 7.3 kilometers, respectively, for work during the following year. The completion of these sections will give a continuous first-class road, Manila to Nasugbú, of 93 kilometers.

Plans and estimates are being prepared for a road connecting the Manila–Batangas Road with Lake Taal. This will be a spur of approximately 10 kilometers and, when constructed, should be a popular drive for Manila tourists to visit the Taal Volcano. It will connect Lake Taal with Manila with 81 kilometers of first-class road.

Three bridges on the Tuy–Nasugbú Road are under construction—two arches of 15 and 18 meter spans and a steel bridge of 160-foot main span with 48 and 36 foot I-beam approaches. The arches are of adobe stone substructure and spandrel arches with concrete main arches and handrail.

The presidencia at Lemery has been completed and was dedicated on August 15, the official fiesta of the municipality. The provincial and municipal officials joined in the dedication.

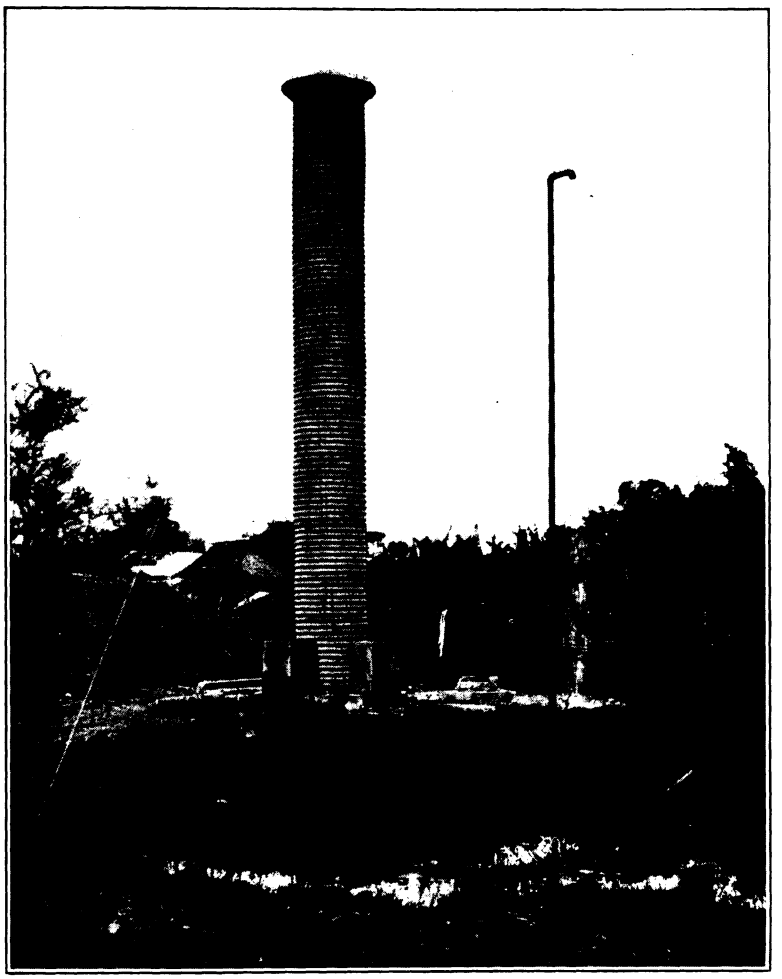
Three markets have been finished in the province during the quarter—a 24 by 68.7 meter type "B" in Batangas at a cost of ₱26,000, a 21 by 39.8 meter type "B" in Lemery at a cost of ₱13,300; and a 15 by 43.5 meter type "A" in Santo Tomas at a cost of approximately ₱11,000. The first-mentioned market was completed for ₱3,500 less than the Bureau estimate and ₱8,000 less than the lowest bid received. Authorization has been received for the construction of an 18 by 30 meter type "A" market at San José. Bids have been received, but contract is not yet signed.

Two school buildings have been completed during the quarter—a plan No. 4 at Tuy by contract, at a total cost, including surcharges, of ₱8,700, and a plan No. 2 at Banaybanay at ₱4,800. Construction has begun on a revised plan No. 10 in Bolbok. This town is in a very isolated section and considerable difficulty has been experienced in getting material to the site. However, the last of it has finally been received and the school ought to be ready for occupancy by Juanary 1, 1916. On account of the difficulty in getting material on the site during the wet season, it was intended not to begin construction until after the rainy season, but the old building being burned, construction is being rushed. The high cost of steel and the costly transportation are seriously affecting the cost. Authorization has been received for the construction of a plan No. 4 school building in Talisay, but work will not be started before the rainy season is over.

Two band stands have been constructed on the plaza of Batangas. They are of concrete base, floor, and columns, with galvanized-iron roof. They are duplicates and cost ₱1,000 each.

All the municipalities of the province have become very much interested in water supplies. Plans have been made for water supplies for Batangas, Lipa, and Cuenca. The water supply for Balayan has been completed. This town had two good flowing artesian wells, one, to which the system is connected, flowing approximately 250 gallons per minute at ground level, the water rising to 25 feet above the ground. A standpipe of 1,300 gallons capacity was used to give pressure, connected with a 6-inch pipe to the main street, 3-inch pipe on all principal streets, and 1½-inch pipe on side streets. Public hydrants are placed at various places on the streets and a number of houses have been connected, practically all houses expecting to be connected. The system will deliver water to the second story of any house in the town and makes a very good supply for domestic purposes. The hydrants on the 3-inch mains are made with a 2½ by 3 inch tee with a butterfly bibb on one side for supply purposes and a plug on the other for use in case of fire, when there are some provisions made to furnish pressure. A resolution has just

been received from the municipal council requesting the district engineer to make investigations and recommend to the council some suitable fire engine for their needs, with the cost of same. The system as it is, with 1,500 meters of street mains and 15 hydrants, including cost of stand pipe, installation, and surcharges, cost the municipality ₱4,350. The officials of the town are so well pleased



Standpipe, 3 feet in diameter by 25 feet high, for Balayan Waterworks, Batangas Province.

with the system that they have decided to connect the second well with a similar system next year and put pipe on practically all streets and alleys. They have fixed a monthly rate of ₱0.50 for all houses connected, and since all houses practically are connected and the cost of operation is zero, it makes a good investment for the municipality.

Taal water supply, at present the most important project, is well under way. The pipe has all been received and distributed. The excavation for the reservoir is completed and concrete is being placed, and excavation is being made on the well at the springs and pump house. December 12 being the date of the town fiesta, it is the desire of town officials to inaugurate the system on that date, but the present time being rice-harvest time it is hard to get labor, hence it is not certain that the project can be finished by that time. The source of water is to be three springs of 60,000, 90,000, and 150,000 gallons daily flow, respectively. The well at the pump house will be of 100,000 gallons capacity and the main reservoir of 300,000 gallons capacity. The pumping system will be a duplicate set of 20-horse-power, Otto Diesel engines and 2 Gould pumps with a capacity of 250 gallons per minute each under 100 pounds pressure. The pumps will have to work under about that pressure, and the pressure obtained in the central part of town will be about 60 pounds. The system has been designed to supply the town of Lemery also, but they will not be connected for the present.

Six artesian wells have been drilled in various barrios of the municipality of Batangas during the past three months, all successful pumping wells. Drilling is now in progress on the seventh, with three others in prospect in this municipality. Two have been drilled in Bolbok, the first a good pumping well, 650 feet deep, water 27 feet from surface, and the second 440 feet with a flow of 25 gallons per minute.

## BENGUET.

The Benguet automobile line carried 579 passengers and a total of 44,552 kilos of express and baggage during the period July 1 to September 30, 1915.

The records of the Mirador Observatory up to September 30, 1915, show the present rainy season to be the mildest that has been experienced in this locality since the establishment of the observatory. The Benguet Road for the first time in its history has been maintained without interruptions to traffic and no difficulties encountered in maintaining the Naguilian Road in good condition. The work of resurfacing the latter road is progressing in a satisfactory manner and it is hoped to have sections of the road, where it was necessary to use sandstone surfacing in construction, completed before the end of the year. A No. 4 Champion crusher and about 100 rock breakers are now being employed on this work.

Transformers required in order for the city of Baguio to utilize power from the military hydroelectric plant for lighting and other purposes have been delivered in Baguio and connection with the military system will be made before October 31, 1915. The articles of agreement provide that current will be furnished the city for distribution to the public of Baguio at ₱0.06 per kilowatt hour and the city to charge consumers actual cost plus 10 per cent. This will allow at least a 50 per cent reduction in the present selling price of current of ₱0.40 per kilowatt hour. The city is also required to hold its present plant in reserve in case of breakdowns or other emergencies and to supply the military in such cases with 50 per cent of the power developed at its plant.

The reconstruction of a 66-foot timber pony truss bridge with girder approaches across the Trinidad River at La Trinidad, Benguet, for the Mountain Province, will be completed in about fifteen days. With the completion of this bridge it will be possible for small touring cars to go over the Mountain Trail from Baguio to kilometer 12.

The Mount Data Trail from kilometer 88, Mountain Trail, to Sabangan was opened to traffic during August, reducing the distance between Baguio and Bontoc by about 40 kilometers; the distance via the new trail being 165 kilometers. The telephone line from Baguio to Bontoc, which follows the new trail, and which has been under construction for the past year, will be completed during October, making it possible to talk with all the subprovincial capitals, except Apayao, from Baguio by telephone.

Surveys and investigations are now being made by this office with a view to improving the "Cervantes Trail," from Tagudin to Cervantes, for light automobile traffic. The present trail is passable for narrow-tread bull carts which are used for hauling freight from the coast to the interior of the Mountain Province.

Plans of grounds and buildings for the Northern Luzon Fair to be held in Baguio from December 27, 1915, to January 2, 1916, have been prepared by Mr. E. L. Bachmann of the Consulting Architect's office and Mr. Henry Sandkuhl of this office. Grading work and the construction of buildings will be accomplished under the supervision of Mr. Sandkuhl, as chairman of the committee on grounds and buildings, and the city engineer's office. Buildings will be constructed of Benguet pine with suali sidings and partitions and tar paper for roofing.

## BOHOL.

The subgrade of the Loboc–Bilar section of the Loay–Interior Road is now almost complete, rains having prevented its completion before this time. The first automobile arrived with difficulty in Bilar on September 8, but now the trip is very easily made. It is proposed to extend this road to Batuan next year. In the meantime, work on the surfacing will go ahead on the arrival of the rock crusher ordered from the States. This road has a maximum grade of 8 per cent and is the scenic road of this province.

The Anahauan Bridge of three 7.5-meter reinforced-concrete girder spans on concrete pile foundations will be completed early in October. All the bridges on the Dauis–Panglao Road have been replaced by concrete structures.

Several third-class roads have been repaired recently, among them being Tagbilaran–Corella, Corella–Balilihan, and Loboc–Sevilla. The second-class road from Dauis to Panglao is now being repaired.

Messrs. Kipp & York of Cebu have completed three school buildings, La Paz (standard plan No. 2), Loon (standard plan No. 7), and Calape (standard plan No. 6). The Ubay building (standard plan No. 7) is also about 90 per cent complete. The contractors began work on June 7 and will complete all the buildings before October 20.

The Mabini School (standard plan No. 7) has at last been begun by administration, the tardiness of the arrival of the material from Manila being the cause for the long delay. The people of Mabini are public-spirited and are doing all in their power to expedite the work. Mr. Damian Corona, the municipal president, especially deserves praise.

The road from Inabanga to Tagbilaran is now surfaced throughout, although part of the surfacing is narrow. This will be widened as traffic increases. An auto line is being operated from Tubigon to Jagna, a distance of 117 kilometers. More than 225 kilometers of road in this province are passable for automobile, except immediately after heavy rains.

### BULACAN.

The Pulilan Market, an 18 by 30 meter structure, is well under way. This building is being erected by administration. The president of the town, Mr. Gregorio Calderon, is to be congratulated upon the success of the efforts which he has put forth to secure this market.

In spite of two bids lower than the estimate of the district engineer, the municipal council of Malolos decided to construct its new market by administration. The council took this action because both at Bulacan and at Baliuag the administration work had been completed within a shorter time than was provided for in the proposals of the contractors. In this case the municipal council, on July 7, 1915, voted to construct by administration. Two weeks later the first column was poured and by September 15 not only were all of the columns completed, but the roof timbering was in place and a large part of the floor laid. If the Bureau of Supply is able to furnish the roofing materials on time, this building, a 30 by 48 meter structure, should be completed by November 1.

The Bintog School, a 2-room structure, has been completed. This structure is located in the barrio of Bintog, municipality of Quingua. Its final cost was ₱4,894.32, including surcharges of slightly less than 10 per cent.

As a result of the efforts of Mr. Francisco Sebastian, the municipal president, the town of Hagonoy is to have a modern and up-to-date presidencia. Recently some of the timbers in the second floor of the old presidencia building failed, injuring a number of people. As a result, the president set about to erect a new and more desirable structure. A site was secured near where the old building had stood and ₱30,000 was borrowed for the construction of the new structure. When the new building is completed, the municipality of Hagonoy will undoubtedly have the best presidencia building in this province.

Notice has just been received that the Bureau of Education has alloted sufficient funds to enable the construction of new schoolhouses at Guiguinto and at Bigaa. The Guiguinto building will be a 4-room structure and the Bigaa building a 6-room structure. These municipalities have been decidedly in need of more adequate accommodations for the school children, a need which the new buildings should adequately meet.

### CAGAYAN.

Frequent rains during the last three months have interfered with all public works in this province, especially with the progress of construction on the Babogan Bridge. The timber pile foundation for one of the channel piers has been completed and the reinforced-concrete piles are being driven.

Road construction between Tuguegarao and Alcala is moving along as well as could be expected, considering the season. It is planned to complete the subgrade to the Pared River on kilometer 34 as soon as possible and thereby make available for surfacing the gravel deposits in that river.

The pile hurdle being constructed by the dredge *J. M. Dickinson* at Camalaniugan to correct the Cagayan River channel at that point has been completed, and a mattress is being placed to prevent underscour. The funds appropriated last year for this work were insufficient to properly maintain the dredge and complete the work that was at that time under construction.

Work is being started from a special allotment of ₱30,000, made by the Secretary of Commerce and Police, for reopening the old canal between Linao and Abulug. The allotment is not sufficient to complete a canal of sufficient cross-section to accommodate the traffic which is expected to develop, but an effort is being made to open a channel to accommodate small craft, with the intention of enlarging it when funds become available. When complete, it will connect Aparri with the municipalities of Abulug, Ballesteros, Sanchez Mira, and Pamplona.

### CAPIZ.

Practically all the gravel necessary for resurfacing the Calivo–New Washington Road, kilometers 1 to 7, inclusive, has been delivered. A small gang with an 8-ton roller is making rapid progress in resurfacing in anticipation of increased motor traffic. One passenger automobile is now operating on this road and another is in transit to New Washington. An auto truck will soon be put in operation from Calivo to New Washington to haul the hemp and copra, which constitute the big items of export from that section.

The third-class road from Ivisan to Sapian is being opened up for wheeled traffic by clearing, light grading, and the reconstruction of some 30 wooden bridges and culverts. Due to the scarcity of local timber, this road has been out of commission for wheeled traffic for a number of years.

The launch *Antique* has been purchased by the Province of Capiz and renamed *Inmediata*. She will handle passenger traffic, especially between the ports of Capiz and New Washington. It is proposed to make three round trips each week on regular schedule. The launch will also be available for charter on days off regular schedule. Her successful operation will be a distinct advantage socially and commercially to the people of the eastern and western sections of the province and will greatly facilitate the prosecution of public works in the western section. The *Inmediata* is operated under the direction of the provincial treasurer.

Construction has commenced on the 3-room school buildings at Pilar and Ivisan. The work is being done by administration. It is anticipated that both buildings will be ready for occupancy in December.

On October 1 bids will be opened for the following bridges:

| No. | Road. | Type. | Span. |
|---|---|---|---|
| | | | *Meters.* |
| 1.4 | Capiz-Libas | Reinforced-concrete slab and girder on pile foundation. | 10 |
| 27.9 | Capiz-Dumarao at Dao | Collapsible wooden deck, 6 spans | 36.6 |
| 35.6 | Capiz-Dumarao at Cuartero | Collapsible wooden deck, 10 spans | 61 |
| 30.4 | Dao-Mambusao | Concrete arch, 30° skew on pile foundation | 22 |
| 8.2 | Calivo-Ibajay | Reinforced-concrete slab and girder on concrete pile bents, 5 spans. | 35 |

No 35.6 requires training works, to consist of two spur dikes containing a total of some 725 cubic meters of rock. The first four of these bridges will close all existing gaps in the through road from Capiz to Dumarao and branch roads and provide for through traffic on 110 kilometers of road in the eastern end of the province, 88 kilometers of which is first-class. The last-named bridge will eliminate the only temporary crossing in the first 24 kilometers west of Calivo.

### CAVITE.

The province has secured a loan of ₱10,000 to construct a concrete bridge in the town of Cavite on the street leading to the Navy hospital at Cañacao, to replace a very poor old wooden structure. This loan was secured through the efforts of Commander Moses of the Navy. The new bridge will have three spans of 7 meters each of the reinforced-concrete slab-and-girder type on concrete piles, the balustrade to be of the type known as the Marinduque Bridge balustrade. There will be two concrete sidewalks, and concrete lamp-posts at each end of the balustrade. The navy yard has agreed to loan the province the use of either a floating pile driver or a ground driver. It is expected to commerce construction October 1, and have the bridge finished by the latter part of November. The road from the Cañacao Hospital, back of which the three big 650-foot aërial towers are being constructed, to the Cavite–Noveleta Road has been declared provincial road and will be reconstructed as first class during the coming year, so that the completion of the concrete bridge will give first-class road connection with the Noveleta–Cavite Road.

A great deal of influence is being used in an endeavor to secure sufficient funds for the construction of the road from Cavite to Noveleta. This will make a first-class road to Manila, with the exception of a 3-kilometer section of second-class road between Kawit and Binakayan. The total distance is 9.6 kilometers, of which 2 kilometers in Cavite have been completed. Kilometer 30 lies in a tidewater swamp and will require a dyke built on each side the width of the shoulder at the top with $1\frac{1}{2}:1$ slope on the outside and $\frac{3}{4}:1$ slope on the inside. These dykes will be about 2 meters high and will be mucked up from the swamp mud. Then the space between will be filled with sand from the beach and topped off with a layer of adobe stone on which the rock surfacing will be laid. This kilometer parallels the railway embankment, which lies on the outside of the road and directly on the beach, thus protecting the road from the water during storms. The cost of this 1 kilometer will be about ₱25,000, and the cost for all work including bridges to complete the road is ₱116,000, which it is believed will be appropriated during 1916. The road is not only important for the town of Cavite, but is quite necessary as a protection to the big aërial station at Cañacao, should it be necesary to get troops to the site overland during stormy or bad weather.

The well-drilling machine in this district has been averaging about one good flowing well each month. The rig has completed five flowing wells in the municipality of Bacoor and is now moving up to Tanza, where a well will be drilled in the barrio of Julugan. The rig will then go to Amaya and the barrios along the beach toward Naic, where there is no water except that in shallow holes.

Two No. 7 schoolhouses are now being completed, one in Tanza and one in Silang. All walls and partitions are of concrete, with redwood ceilings, narra doors and windows, and American ingot-iron roofs.

The cost of Tanza building is ₱16,500 and the Silang project about ₱19,000, the difference is in transportation of material, the haul for Silang being 30 kilometers.

The survey for the Silang extension, which is eventually to extend through the entire back part of Cavite Province and connect with the Batangas Road system at Tuy, has been completed for a distance of 14 kilometers, or to the top of the ridge back of Silang and directly above Taal Lake. The question of construction at this time depends upon the finding of suitable road surfacing material around Taal and the lifting of it the 2,000 feet of elevation to the top of ridge. An endeavor to find stone around Talisay revealed small amounts in two streams which would not be practical to handle as the stone is scattered in large boulders which would have to be broken first by explosives, then by hand, then concentrated in some central spot, hauled to the lake, and transported to the foot of an aërial cableway for hoisting the material to the top of the ridge. If stone cannot be found and delivered to the top of the ridge by cableway, it will have to be shipped from Los Baños to Binakayan and hauled from there up grade for an average distance for the whole section of 35 kilometers, which at the rate of ₱0.40 per cubic meter kilometer amounts to ₱14 per cubic meter for cart transportation alone, making the total cost of stone laid on the road about ₱18 per cubic meter. This, of course, is out of the question at this time, and the only solution with justifiable cost is to get stone from Lake Taal and raise it to the top of the ridge at a reasonable cost.

### CEBU.

Work on the Cebu waterfront improvements is proceeding as outlined in the July BULLETIN. A 30-foot channel is being dredged along the new wharf and for about 200 meters beyond. Along the section of the old sea wall, from the customhouse to the angle, the depth at the wall will be 25 feet, sloping to 30 feet at 50 feet out. In the vicinity of the new wharf a layer of cemented shell and gravel, from 0.20 to 0.40 meter thick, was encountered at a depth of about 27 feet. This varied a great deal in character, in places approaching concrete in density and hardness. Where this was the case, it had to be broken up before dredging. After some experimenting it was found that 15 sticks of dynamite placed on the bottom, from which all loose material had been dredged, and covered with sand or rock would do the work. The charges wrapped in burlap were placed by a diver and fired from the wharf, one at a time, using two dry cells, with lamp cord for lead wire. Connections between lead wire and exploders were well wrapped with adhesive tape and none of the shots missed fire. An area of about 2,000 square meters was covered in this way, the average spacing of the shots being about 10 feet.

The fill behind the new wharf has been completed to grade for about half its length. Fourteen thousand cubic meters had been placed up to September 1 and it is estimated that 8,000 cubic meters will complete the work. The material now being placed is sand. Considerable settlement has taken place in the old rock fill behind and under the wharf and it was found necessary to extend the curtain wall to the surface, using a reinforced section, terminating in a surface drain and air vent.

Paving is completed from the market to the angle of the wall and is being pushed as fast as weather and traffic conditions permit. A short section between the railroad track and the sea wall, laid originally with an inferior brand of asphalt, has had to be replaced. The binder had deteriorated, probably under the action of sea water, to an oily consistency with no adhesive power whatever.

Early in July a fire started from spontaneous combustion in the customs coal shed, but did not get beyond control. The building is in very bad condition and it is proposed to replace it with a structure of the same type, but with a raised floor. At present the coal lies on ground which is subject to overflow, and this condition is presumed to have been the cause of the fire.

Construction work on the Cebu–North Road has proceeded with great rapidity during the past quarter. At times as many as 2,500 laborers have been employed. All of the 23 kilometers of subgrade have been finished and 7 kilometers of surfacing placed and rolled. Three rollers are working on this job.

The Barili–South Road is now completed to Moalbual, kilometer 88+400.

Contractors Kipp & York have just completed a standard No. 4 school in San Francisco, Camotes Islands. This work was started on August 9, 1915, and finished September 9, 1915, making twenty-six working days. Work has been started on the Daanbantayan School, a similar plan, located in the central barrio of Daanbantayan.

The installation of Sibonga water system, which was began last July, is nearly finished. The spring is about 4 kilometers from the town at an elevation of 106 meters above the sea level. The flow is about 150 gallons per minute, which, for a town like Sibonga, is enough for both water consumption and electric light installation, if so desired. The pressure is about 70 pounds per square inch under ordinary conditions. From the spring the pipe line consists of a 3-inch galvanized-iron pipe up to the distribution reservoir, which is located, at an elevation of 50 meters, about 500 meters from the town. The reservoir has a capacity of 85,000 gallons. From the reservoir the main distributing line consists of a 6-inch cast-iron pipe. It is hoped that in the near future the town of Sibonga will be able to install an electric plant to make use of the excess water that can be obtained from the spring.

### COTABATO.

The work of surfacing the Cotabato–Tamontaka Road has been progressing satisfactorily. Three and one-half kilometers have been surfaced with limestone gravel and have been placed in such condition that they may be declared first class at the end of the year. There is still 1 kilometer to be surfaced and with the 2 kilometers finished the previous year this road will be in very fine condition for all traffic with the exception of the Tarbung River crossing. A ferry is being placed in this river, but it is hoped that sufficient money may be obtained to place a permanent bridge on concrete piles across this stream the coming year.

A timber bridge was built across the Tarbung River sometime ago, but lasted only eight months, owing to the rapidity with which the teredo infesting tidal streams in this province consumed the dungon piles used in its construction.

A No. 60, 6 by 3 inch, Rife ram is being installed in the Nituan River to supply water for the town of Parang. The water is to be pumped into a concrete tank 30 feet high, situated on a hill 240 feet above the river. The head on the ram will be 20 feet and it is expected to obtain a delivery of 10,000 gallons daily to the tank.

Work on the Government rice mill is being pushed to completion. It is hoped that the mill will be working full blast by November 1, as the palay crop will soon be harvested and it will be needed to mill the raw product into rice as soon as completed. The capacity of the mill is 500 cavanes of palay per day. The fuel will be palay hulls and all handling from the time the palay is put into the hopper until the finished product is obtained, including the delivery of hulls to the furnace, will be done automatically.

Surveys and investigations for an irrigation canal for the rice colonies located near Fort Pikit are nearly finished. The plan is to bring water from the Maridagao River by a gravity canal 13 kilometers long. The area to be irrigated is about 4,500 hectares and the canal must deliver 5 cubic meters per second to furnish sufficient water for this ground. It is hoped that money can be obtained for this project the coming year, as the Cotabato Valley is subject to severe droughts which for the past two years have been disastrous to all crops, especially rice. However, there is sufficient water available to irrigate practically the whole valley and if irrigation methods are once established, droughts need no longer cause apprehension among Cotabato rice growers.

A waterworks scheme for the town of Cotabato has also been developed from a waterfall in the Simuay River, which can furnish power to work a ram and a small hydroelectric plant. Another scheme for dredging the Cotabato River from its mouth to the town and straightening it so that the largest interisland boats can enter and discharge their cargoes direct is receiving attention. This would do away with lightering freight which now costs 25 per cent of the freight rate from Manila to the river mouth. There is also a concrete wall being projected in connection with the general scheme of improvement.

The first deep well in the Department of Mindanao and Sulu is now being bored at Dulauan. The well is now 350 feet deep and, though no water has yet been found, conditions are very favorable and it is expected that a good flow will soon be met with. The material being penetrated is a stiff blue clay containing a small amount of shell and sand and it is thought that water will be found under this stratum.

Construction will soon commence on a telephone line from Reina Regente to Glan and the most of this line, which is 175 kilometers long, will be finished this year.

A section of line from Pikit to Cabacan has been put in operation. The section is 10 miles long and cost ₱850, including instruments, etc.

Grading has been commenced on the Kudarangan–Fort Pikit Road and to date about 2 kilometers have been finished. This grade has a standard width of 7 meters and a full right of way of 15 meters is being claimed. This is the first link in a road project to extend across the Island to Malaybalay. About 60 miles of this road will lie in Cotabato Province north of Fort Pikit and it is expected that a serviceable horse trail will be built for the entire distance during the coming year.

### DAVAO.

No project notes received.

## ILOCOS NORTE.

One of the most important projects in this province is the construction of the Laoag Bridge extension over the washout section of the destroyed spillway, Laoag–San Nicolas Road. This bridge is of the slab-and-girder type, consisting of five 9-meter reinforced-concrete spans supported on concrete pile bents. The work on this project has been considerably held up on account of delay in the delivery of pile-driver parts from the Bureau of Supply. The pile driver is being set up and driving piles will commence in a few days.

The construction of sanitary concrete sales tables for the Laoag and Batac Markets has been completed. These tables serve in stimulating and arousing more commercial interest and activity among the people of the two towns and their surroundings.

Work on the Bacarra and Badoc Markets is progressing very rapidly, 50 per cent of the work being completed on the two buildings.

Badoc School is being laid out. Total estimated cost is ₱16,000, and the amount appropriated is ₱14,573.22.

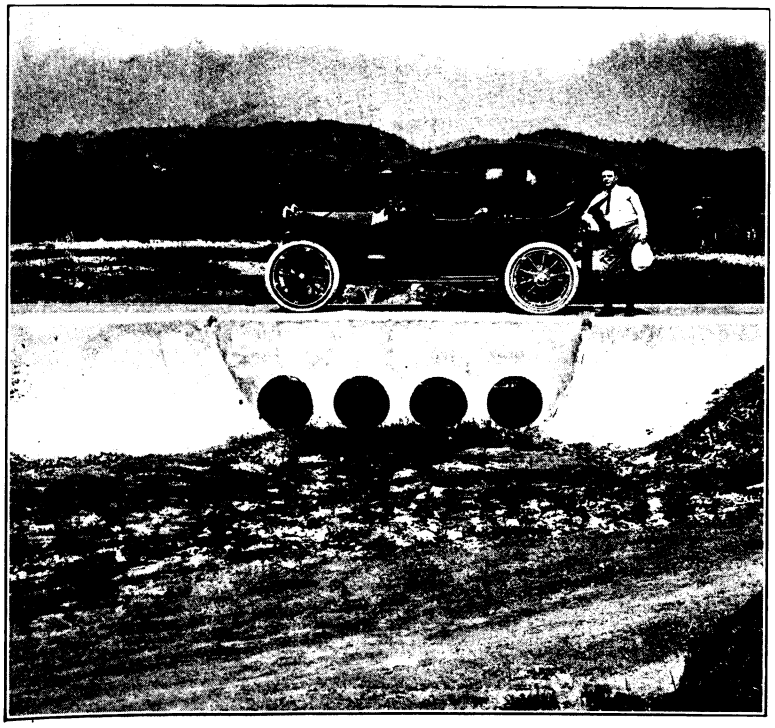
Reconstruction of San Nicolas School will soon commence. Requisition for materials is being prepared. The total amount of funds available for this work is ₱8,000.

There has been no hard continued rain in this part of the Islands during this year, hence the question of maintenance has not yet assumed the importance that it had last year. All sections of second-class roads have at all times been passable by all kinds of traffic, except during high water in those rivers where it is impossible to maintain *balsas* or to construct crossing. One section of the Laoag–Bangui Road, at kilometer 33, needs resurfacing; but, as the present available funds for the maintenance of second-class roads does not warrant any extra expenditure, this section has been let off as it is up to this time. To insure certain possibility of all second-class roads throughout the year, the district engineer has requested a transfer of funds to be expended for the improvement of this particular section.

The continuous increase of heavy truck traffic on the first-class roads has kept the maintenance force busy in preserving the roads in such a condition as to be able to stand the everyday wear of running autos and trucks. The application of macadam construction upon those slight damages done by the heavy vehicle traffic has proved a very satisfactory remedy to the situation.

## ILOCOS SUR.

A survey has been made on three locations of a proposed road from the barrio of Solvec, municipality of Narvacan, 25 kilometers in length to connect with the Bangued–Pidigan Road in the subprovince of Abra, through a mountainous section of country. The steepest grade is 10 per cent, and the highest point above sea level is 150 meters. This road will be of great benefit to the people of Abra, for the only means they have of bringing their salable products to market is by rafting down the Abra River to Pandan, the port of Vigan.



River-control work, project No. 85, showing concrete-pipe culverts, Ilocos Sur.

Maintenance of all first-class roads in this province has continuously improved during the last quarter. Earth depositories have been constructed and reconstructed and well sodded with grass on the entire 141.3 kilometers, shoulders and slopes have been properly looked after, and proper drainage attended to.

Construction of Vigan–North Road and bridges, project No. 10, kilometer No. 3, Ilocos Sur Province.

All second-class roads in this province are in such excellent condition that when the Governor-General and party came to Vigan in August, which is the rainy season here, for the inauguration of the Singson Waterworks, no difficulty was encountered on these roads, and creditable comment was made by His Excellency and party. These roads have been converted into sand-clay sections, which, with proper drainage, work all right during the rainy season.

At the last designation of first-class roads, which was June 30, 1915, 9 kilometers of newly constructed road were reported on the Vigan–South Road. At present the province can boast of having 69 kilometers of first-class road on this section, without a break, except at three large rivers—the Abra, the Santa Maria, and the Santa Cruz. Cost of construction on the newly designated road was ₱5,000 per kilometer.

Condition that existed before concrete spillway was constructed; kilometer 21, Ilocos Sur Province. River-control work, project No. 85.

On the Vigan–North Road, 3.9 kilometers of newly constructed road were reported for the six months ending June 30, which make

a total of 39.6 kilometers of first-class roads on this section. There are still three breaks on this road, one at the Parsua River and two others through the municipalities of Cabugao and Sinait. These sections will be converted into first-class road in the near future, and when completed the entire Vigan–North Road will be without a break, all streams being bridged.

The Bucay barrio school building (standard plan No. 3) was completed on June 30 by administration at a cost of ₱7,966.17. Estimated cost, ₱8,107. This school is located 42 kilometers from Vigan, and all materials had to be rafted up the Abra River from the port of Pandan on bamboo rafts, cost of transportation amounting to ₱914.06.

All work on the Santo Domingo Market has been finished with the exception of the concrete floor, which is 80 per cent completed. The market is of standard type, size 18 by 42 meters, estimated cost ₱15,016. At present the entire building is 96 per cent finished. Cost of construction up to August 31, ₱10,548.13, including all charges. Cost of completed building will come less than the estimate. Work is being done by administration.

The Cabugao Market lacks only the concrete floor, same being 50 per cent completed. It is of standard type, size 21 by 43.5 meters, type "A," estimated cost ₱19,006. At present 94 per cent of the entire building has been completed. Total cost to date ₱12,459.50, amount appropriated ₱15,756.84. The building when completed will come under the estimated cost. Work is being done by administration.

Concrete spillway, kilometer No. 21, Vigan–North Road, Ilocos Sur Province. River-control work, project No. 85.

The Candon Market is being constructed in accordance with standard plans. It is 21 by 39.8 meters, type "B," amount appropriated ₱19,846.70, and 45 per cent of the work is completed. The total amount expended up to August 31, 1915, was ₱12,396.20, and the building when completed will come under the estimated cost of ₱17,021.

### ILOILO.

No project notes received.

### ISABELA.

Construction on the Angadanan–Cauayan Road has been suspended on account of rainy weather and shortage of funds. This work was constructed partly with provincial funds and partly with Insular. Grading has been completed on almost 6 kilometers (45–50) with sufficient pipe culverts, the Paddad Bridge, and three 6-meter provisional bridges. Kilometer 50 is almost completed. This new road is located east of the old one, and, being a straight line for that distance, is 800 meters shorter than the old one. This section is opened to horse and foot traffic.

With the complettion of the Cordon–San Luis Road, this province now has 41 kilometers of continuous first-class road from Angadanan to San Luis. There are only three creeks or rivers in this section not yet bridged.

The construction of a 40,000-gallon concrete water tank for the Constabulary barracks at Ilagan is now under way and is expected to be completed within two or three weeks.

This office is now able to turn over to the Bureau of Education the school building (plan No. 10) located at Ilagan, and within a month's time the construction of a 7-room school building at Echague will be started. Probably some of the lumber to be used for this building will be purchased from the Nueva Vizcaya Sawmill.

The proposed concrete presidencia at Cauayan will be built soon. The municipal officials are only awaiting the approval of a loan from Manila.

The second and third class roads are in general passable for horses and light traffic.

### LA LAGUNA.

The Calamba–Vigaa Road has been completed, except for a section 100 meters long where the Manila Railroad Company is preparing to erect a permanent overhead bridge to carry the highway over their track. Pending the construction of this bridge and the unfinished gap in the road, traffic is diverted and passes over the old temporary bridge erected when the railroad was built. The newly constructed road was built on an almost entirely new alignment and grade, necessitating the construction of a number of new culverts, and the abandonment of much of the old right of way. The surfacing is built with very little crown save on grades, and has shoulders ranging from 4 to 5 meters wide, according to the character of the section. The curves are superelevated, the culverts have a clear roadway of 7 meters, and only in one place is the maximum grade of 5 per cent used.

Work on the San Pablo–Nagcarlan Road has been continued and there now remains 5.5 kilometers of surfacing and 1.2 kilometers of grading to be done to complete the road to Nagcarlan, 15.6 kilometers from San Pablo. The grading yet to be done is rather light and with favorable weather conditions will soon be completed. The unsurfaced grade is, for the most part, a disintegrated adobe and stands up under traffic fairly well when given proper maintenance. It is hoped that funds may be available another year to continue the construction of this road from Nagcarlan to Sambat de Magdalena, a distance of 8.5 kilometers, where the Santa Cruz–Pagsanjan section of designated first-class roads will be connected with, and another large section of rich and interesting country added to that now accessible to automobile traffic.

During the past three months the 22-meter reinforced-concrete arch bridge across the San Cristobal River at Calamba and the 73.4-meter steel truss bridge across the Balanac River at Pagsanjan have been completed and opened to traffic.

Maintenance work has been hindered somewhat this year by lack of rains. Plans had been made to put from 1 to 2 inches of fine stone on the Calamba–Los Baños Bay section of the Manila–South Road, and to roll it into the surface with 10-ton roller, but the weather has been so dry that it is very hard to get the stone to bind. However, there is still plenty of time for the expected rains to come.

Work on the forestry building at the College of Agriculture has been suspended while awaiting the appropriation of additional funds, and the building will not be completed until early next year. This is a standard Bureau of Education No. 7 building, with a special arrangement of the interior partitions, and is located on the slope of Mount Makiling approximately a kilometer above the College of Agriculture.

Bids were opened on August 26 for the construction of 26 tiendas at the San Pablo Market, and although one of the bids was slightly lower then the district engineer's estimate, the municipal council decided on September 10 to have the work done by administration. The materials are now being requisitioned and work will be started shortly.

School buildings have been authorized at Bay and Alaminos, a No. 4 plan at Bay and a No. 6 at Alaminos. Bids were asked for on the one at Bay, but none were received, and construction by administration will be started at once. Bids for the one at Alaminos are being requested locally, to be opened on October 10.

It is expected that the construction of a market in Calamba and a No. 6 or No. 7 school building in Lumban will be authorized soon, and that construction in both cases will be started before the end of the year.

The Malvar Waterworks at San Pablo were completed and turned over to the board of waterworks commissioners for operation on September 30.

Surveys, plans, and estimates are being prepared for water-supply systems in Nagcarlan, Los Baños, Majayjay, Calamba, and Pagsanjan. The first three are gravity systems, taking water from springs, while the last two are pumping projects, taking water from deep artesian wells.

The output of the Bureau of Public Works quarry at Los Baños for the quarter ending June 30 was 12,364.25 cubic meters and was the greatest of any since the quarry was opened. The output for the quarter ending September 30 will probably not exceed 4,700 cubic meters, there being very little demand for stone during the quarter, except for fine stone to be used on maintenance work.

## LANAO.

Construction on the Iligan–Overton Road was started in July. This is a section connecting the town of Iligan with Camp Overton and the military road from Overton to Camp Keithley on Lake Lanao, a distance of 5.1 kilometers, of which 4.4 only are under the control of the provincial government. This road was originally built by the Spanish Government for a railway line from Iligan to the Spanish garrison on Lake Lanao and the Moro settlement of Marawe. The old roadbed continues for a distance of about 6 kilometers from Iligan, and then ends abruptly at a steep bluff. The original roadbed was approximately 3 meters wide, with almost no metaling until the American occupation, when the military authorities made it passable by placing heavy coral as a foundation. With a few repairs, this was made to serve until the present work was started, consisting of widening the road to a 5-meter surfacing. This was necessary, owing to the increase of traffic. A daily traffic census is as follows:

| | |
|---|---|
| Auto trucks, rubber tire | 6 |
| Automobiles | 8 |
| Two-horse rigs, 4 wheels | 84 |
| One-horse rigs, 2 wheels | 20 |
| Bull carts, 2 bulls | 10 |
| Bull carts, 4 to 6 bulls | 4 |
| Horse and man | 20 |
| Other animals | 20 |
| Pedestrians | 400 |

A peculiar situation presented itself on this road at station 4+300. At the mouth of a small stream the roadbed was low and springy and had been placed on silt and river deposits, because the river did not have sufficient flow to keep its mouth free of sand washed up by the sea, so that silt and débris were deposited, which accounted for the situation as encountered when a 10-ton roller was placed at rolling this section. Coral stones about 15 to 20 centimeters thick were placed on the old roadbed, covering the entire surface, and when the roller was started these sank and soft silt appeared on the surface and between the stones. Another layer of the same sized coral was placed and but slightly rolled, and on this was placed 10 centimeters of gravel. This was also rolled, but silt appeared again before the gravel was compact enough to receive the second course. Longitudinal ditches were then dug to a depth of 3 feet and 1 meter apart through the road, with cross drains every 3 meters. These were then filled in with large gravel to within 20 centimeters of the surface, when fine gravel was added. This method, while not eliminating all of the silt, nevertheless made it possible to obtain a firm base. The rising tide kept the ground moist, and by the drainage system the tidewater was allowed to drain off rapidly and most of the difficulty overcome.

Work on the new addition to the Lanao Provincial Hospital was started August 18, and is progressing satisfactorily.

The construction of the Tamparan–Cabaritan telephone and trail was started August 30. This consists of 50 miles of telephone and trail from Tamparan on the east shore of Lake Lanao to a Constabulary camp in the interior. It connects with the Bukidnon telephone lines on the boundary of the two provinces, and at the same time opens up a heretofore unknown territory and rendezvous for outlaws. Lieutenant-Colonel Gilsheuser, P. C., was instrumental in securing the project.

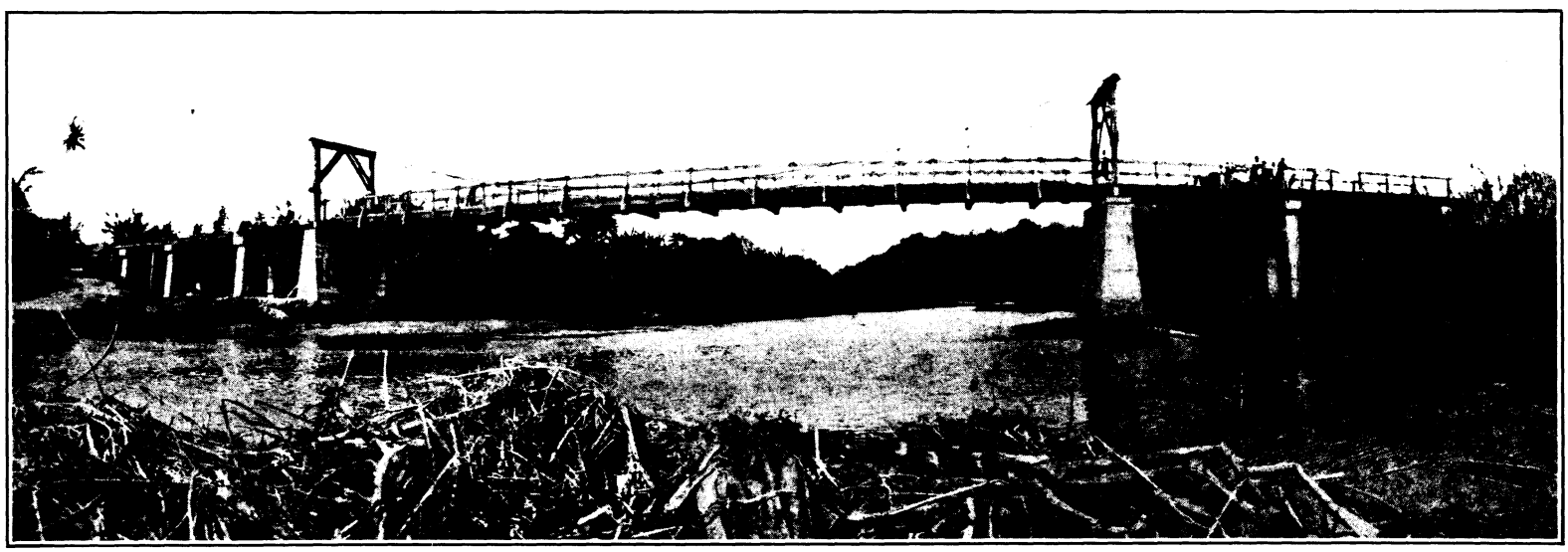
The repair of the Iligan Bridge was finished August 12, and consisted of adding 3 new concrete piers on the north approach and 2 piers on the south approach with 14-inch I-beams and timber decking.

It is understood that the military authorities are to make several changes in the Overton–Keithley Road and to resurface it. This road is subject to continual rains and is in dire need of the repairs. Major Williams, commanding officer, Camp Overton, and Lieutenant Cantus, post quartermaster, both ardent converts of safe and good roads, are urging this project.

The military authorities have started to repair the Pantar Bridge.

## LA UNION.

The maintenance cost of the Bauang–Ribsuan Road, the La Union section of the Bauan–Baguio Road, has been considerably higher since the beginning of the rainy season than for the same length of time during the dry season. From June 15 to September 15 the cost of the maintenance materials used amounted to ₱1,357.22, and the labor, both the camineros and extra gang, ₱1,210.17, while during the period from March 15 to June 15 the corresponding items amounted to ₱38 and ₱997.27, respectively. This extraordinary increase in maintenance cost was due principally to the advent of big trucks transporting freight to and from Baguio, and carrying the same amount of load, about 5 tons, in rainy weather as they do in dry weather. After a rain of some duration these trucks, especially the one with iron tires on the rear wheels, cut two lines of furrows 1 to 3 inches deep throughout almost the entire length of the road, but worse on the Naguilian–Ribsuan section at kilometers 20, 21, 22, 23, and 24, which was formerly a narrow cart trail and was later improved and widened to a 4-meter surfaced section with maintenance funds. This section was built almost crownless, and from present indications the metaling was less than 20 centimeters in thickness. The increase in labor cost was due, however, to a number of slides on kilometers 25 and 26.



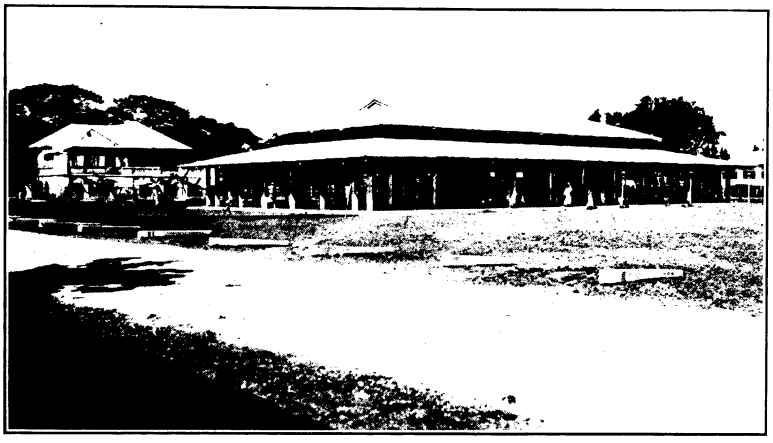
Suspension bridge, Iligan, Lanao Province.

Plan and estimate for the construction and reconstruction of the Caba–Aringay section, 4½ kilometers, of the Manila–North Road through the Province of La Union, have been approved, the estimated cost amounting to ₱50,000, in round figures. There is now available on this project an appropriation of ₱12,385, which will be expended before the end of the year. It is expected that additional appropriations will be forthcoming next year to complete this road.

The survey of the Aringay–Camp One Road was begun in earnest since the 6th of September, 1915, and 8 kilometers out of the estimated distance of 34 kilometers were completed by October 1. A heavy hillside and zigzag location has been encountered in the mountainous region between Rosario and Santo Tomas. The importance of this project cannot be fully appreciated until one realizes the great benefit that its construction will give to the provinces of northern Luzon in general and to the Province of La Union and the city of Baguio in particular. The opening of this road will mean: (*a*) The establishment of a continuous highway from Manila to

Bangui, Ilocos Norte; (*b*) the establishment of a permanent means of communication between Manila and the health resort of the Philippines when the Benguet road is finally abandoned; (*c*) the establishment of another means of communication, besides the railroad, between La Union and the wealthy Province of Pangasinan; and (*d*) the development of new territory in the southern part of La Union.

The construction of the Bauang Market, 18 by 42 meters, was given to a local Japanese contractor for ₱3,000, the province furnishing all the materials. The work was started in a rather bad time of the year, those rainy days in the latter part of July, but in spite of bad weather and serious delays in the receipt of materials, the work has progressed satisfactorily and the building is now about 50 per cent completed.



Municipal market, San Fernando, La Union, P. I.

Note concrete fence posts ready for setting.

A number of deep wells have been tried in various parts of La Union, but only three, all pumping wells, have been found successful so far, one in Bangar, the most northern municipality in the province, and two in Aringay, in the southern part. The average depth of these wells is about 100 feet. All attempts beyond this depth resulted in nothing but salt water. Some drilling was carried to depths of 500 to 700 feet upon the insistence of municipal officials, with the expectation of getting a flow, but it only resulted in the penetration of the salt-water strata, contaminating thereby the fresh-water supply at the higher elevation. A recent hole was drilled in Agoo, in which petroleum gas was struck at a depth of 330 feet.

## LEYTE.

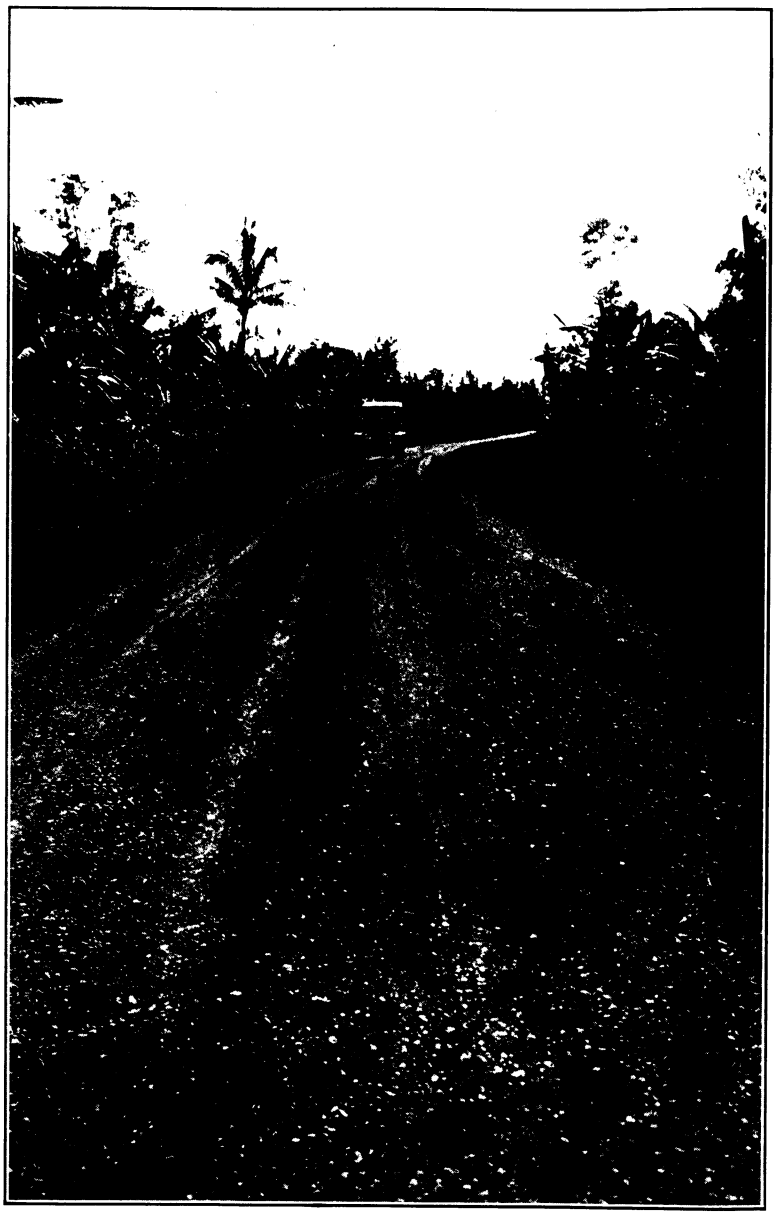
During the past quarter work on the Palo–South Road was delayed by the necessity of replacing the flues in the locomotive. The price of hauling was increased from 8 to about 18 centavos per kilometer-meter as a consequence, and the amount of stone delivered per day was reduced about 40 per cent. During the first week the locomotive was laid off, the attempt was made to pay the men by force account, those who pushed the cars, but the result was anything but satisfactory, the average cost being about 34 centavos per kilometer-meter. The *paquiao* system was next inaugurated by paying one man 80 centavos for each car (⅔ cubic meter) delivered, which brought the price down to from 15 to 20 centavos per kilometer-meter. The haul was about 5½ kilometers. Grading has been completed to kilometer 70 and the surfacing to Mayorga (kilometer 65). The engine is now in good condition and by working day and night is able to make 4 trips in twenty-four hours. By hauling 20 cars each trip, about 50 cubic meters per day is laid, which means a rate of progress of about 1.4 kilometers per month, each kilometer taking 1,000 cubic meters of stone.

First-class road maintenance still remains a serious problem on account of the heavy traffic and the unsatisfactory surfacing materials available. From January 1 to August 15 over 17,000 cubic meters of stone and gravel was bought or quarried for maintenance alone. This rock cost from ₱1.20 to ₱3 per cubic meter and about ₱30,000 additional was spent in hauling same.

An idea of the amount of traffic may be obtained from the fact that during August Leyte exported 50,000 piculs of hemp and the next highest province only 32,000 piculs. The greater part of this hemp is exported from Tacloban, passing over the Palo–South Road and part of the Tacloban–Carigara Road before reaching the port. The trucks that bring it into Tacloban carry rice, firewood, petroleum, etc., on their outward trip, and hence are loaded to full capacity in both directions.

The 5-ton White truck with self-dumping body has proved itself so economical in hauling maintenance stone as compared with carabao carts, which class of hauling costs 40 centavos per kilometer-meter, that the province contemplates the purchase of another truck. With both in operation, it is figured that the hauling cost on maintenance can be cut down about 35 per cent.

In the last issue of THE QUARTERLY BULLETIN it was stated that Dapdap Bridge was completed at a cost slightly under the estimate. This statement was incorrect, as this bridge was built considerably under the estimate as the final figures show. The error was due to the fact that some obligations already paid had not been canceled. The final figures are as follows: Estimated cost, exclusive of approaches and surfacing over structure, ₱22,000; approximate actual cost, including approaches and surfacing over structure, ₱18,800. The work was done by administration.



No. 1. Palo–South Road, Leyte Province, before the effect of heavy traffic.

The Bay tiendas (10 standard 4 by 4 meter tiendas) have been completed by administration and present a very fine appearance. This project, which also includes the market (43.5 by 21 meters), was completed within the estimate.

The No. 2 standard school at Plaridel, municipality of Baybay, has also been completed by administration at a cost of ₱4,978.25, divided as follows:

| | |
|---|---|
| Miscellaneous | ₱421.47 |
| Labor | 1,304.57 |
| Material | 2,769.52 |
| Surcharges | 345.69 |
| Obligations | 137.00 |
| Total | 4,978.25 |

This being an isolated project, the miscellaneous items and most of the outstanding obligations are for transportation. The estimated figures for this project, made in March, 1914, were as follows:

| | |
|---|---|
| Material | ₱2,700.00 |
| Labor | 1,500.00 |
| Supervision | 200.00 |
| Transportation | 400.00 |
| Surcharge | 480.00 |
| Total | 5,280.00 |

In making the foundation tests of Mainit Bridge, a platform about 10 by 10 feet, supported on four legs each 6 by 6 inches, was built and put in place in the upstream half of the excavation after grade

No. 2. Palo–South Road, Leyte Province, after effect of heavy traffic.

Nos. 1 and 2 are the same place; taken six months apart.

was reached. After being carefully leveled, four precise elevations were taken, one on each corner. The platform was then loaded with structural steel weighing 1,268 libras, being 1,268 libras per square foot. After one hour, levels were again taken on the corners and a settlement of 1, 12, 14, and 7 millimeters was noted on corners Nos. 1, 2, 3, and 4, respectively. The platform was then loaded with more I-beams, taking care to distribute the load evenly, to the total weight, exclusive of weight of platform, of 7.6 tons, or 7.6 tons per square foot. After twenty-four hours, levels were again taken and it was observed that corner No. 1 had settled 74 millimeters; corner No. 2, nothing; corner No. 3, nothing; and corner No. 4, 75 millimeters. The platform was then moved to the downstream half and the operation repeated. The final result obtained here was more uniform, corner No. 1 settling 21 millimeters, corner No. 2, 22 millimeters; corner No. 3, 39 millimeters; and corner No. 4, 22 millimeters. The bearing required for this pier was 3.75 tons per square foot. After excavating a little more at the points of greatest settlement (Nos. 1 and 4 of first test), a stratum was reached similar to that encountered at the other points and was considered satisfactory.

In testing the Jaro abutment, where a bearing of 3.05 tons per square foot was required, an average settlement of 35 millimeters with a load of $6\frac{3}{4}$ tons per square foot was obtained at the center and an average settlement of 50 millimeters at the ends, under a load of 6.5 tons per square foot in these cases. These tests were considered satisfactory and concrete is now being poured in both pier and abutment. Mixing is done with a Ransome batch mixer and the work is proceeding in an extremely satisfactory manner. At the present rate of progress the contractor, Mr. J. E. Ainsworth, will have no trouble in completing the project within the contract time of 260 days. It may be of interest to note that the materials encountered in excavating for both pier and abutment the stratifications agreed exactly with the borings. The pier rests on soft sandstone which was reached at *El.* —4.0 as shown on the location plan, and the foundation of the abutment is on a stiff, hard, yellow clay mixed with a little sand at *El.* —4.0, which also agrees with the borings.

Advertisements for bids have been placed for a Bureau of Education standard No. 10 school at Tanauan and a standard No. 7 at Baybay.

Material has been requisitioned and work is already started on a No. 7 school at Barugo and a No. 2 at Tabontabon. Both jobs are being done by administration.

Type of traffic to which Palo–South Road, Leyte Province, is subjected generally—three trucks loaded with hemp.

The concrete tables have been completed in the Tacloban Market and partly completed in the Baybay Market. Only two types were used, one for fish and the other for meats and vegetables.

Materials have been received for the Ormoc and Hilongos Markets, a type "B" 35 by 24 meters and a standard 18 by 42 meters, respectively. Work will commence in about two weeks, both jobs by administration.

Work is proceeding in a satisfactory manner on the Contra Costa Bridges, although some difficulty has been encountered on account of the soft foundation that prevails along this section of the Maasin–Inopacan Road.

Some very excellent second-class road construction results have been obtained between Macrohon and Maasin (14.5 kilometers) and from Bato to Inopacan (23 kilometers).

By an expenditure of about ₱30,000 (exclusive of about ₱140,000 for concrete bridges) in the last two years these roads have been made into excellent light-surfaced highways open continuously and suitable for motorcycles, carromatas, and bullcarts, where before they were impassable for anything but pedestrians and horsemen, except at rare intervals of short duration during the years.

Other roads that shortly will be much improved by an outlay of a very little money, considering the number of people benefited, are the Hinunangan–Hinundayan Road, 5.5 kilometers, and the Malitbog–North Road, 14 kilometers.

## MINDORO.

The construction of the Calapan–Dock Road has been progressing rather slowly. At first the delay was due to lack of suitable binding materials, but at present it is lack of labor. When the work on the project was first begun, a yellow gravel, about 1 centimeter in

diameter and less, was used, but it was found entirely unsatisfactory due to the fact that it had a very smooth surface and was too uniform in size. A binder of finger coral about 5 centimeters deep was tried, but would not bind the gravel. Mixing the gravel with finger coral in equal parts was next tried, but this also failed, for after a day's rolling the road was as seamy under traffic as if the gravel had just been spread. The next method was to try some sand and clay in various proportions and to use a top dressing of coral. This also failed to give a solid road. Finally, the use of gravel as a course was abandoned and hand-broken rock substituted in its place, a small quantity of the gravel being used with the coral dressing. This gave a solid road and at the same time one having a clean appearance.

The subgrade of the Calapan–Jolo Road has been finished to the barrio of Bayanan, a distance of 6.3 kilometers. The surfacing will be begun just as soon as sufficient labor can be secured for breaking rock. Slightly over 2 kilometers of this road already has a 15 to 20 centimeters base of fitted angular stones. Since the width of the metalling beyond the first kilometer is to be 3 meters, the available funds will be sufficient to metal about 3 kilometers of the road. This road takes the place of an old wornout trail, and since its opening there has been a surprising amount of carromata and carreton traffic where there was once only the carabao sled and the pedestrian. A good deal of the traffic is probably due to the excellent crop of rice. Much interest is manifested by the people beyond the barrio of Bayanan as to which direction and how far the road is to be built in the near future.

Work on the Calapan–Baco Road has been intermittent. One section was straightened and rebuilt on a full 15-meter right of way, the land having been ceded by the owners upon payment for improvements.

The construction of the Pulangtubig–Naujan Road is to be resumed as soon as weather conditions permit and right of way adjustments are made. The projection of the road to cross the Magasauangtubig River connecting with the old Spanish road will shorten the distance between Calapan and Naujan by 600 meters. The new road will cross the river more than 1½ kilometers above the present crossing, and less subject to change of channel. Another advantage is that in case of floods less than 150 meters will be liable to inundation, while on the present location there is fully a kilometer of road subject to overflow, about half a kilometer of which zigzags through a cocoanut grove without any definite right of way. Of course, the new location has its undesirable features, one being a small tidal stream at the outskirts of Naujan where it will be necessary to build a 3 by 5 meters culvert, and the other the crossing of the Pinagbaakan River about 100 meters north of the Magasauangtubig crossing, where a temporary bridge of 8 or 10 meters will have to built or a balsa maintained. This latter bridge or balsa might be avoided at the sacrifice of alignment and of the narrow river crossing, by taking the risk of contending with the sand bar that shifts at and below the confluence of the Pinagbaakan and Magasauangtubig Rivers, which would be the problem if the crossing is below the junction of the two rivers.

Work on the Naujan Central Barrio School (plan No. 7) is about to be begun, the materials being expected daily. This project has been delayed on account of the difficulty of landing materials at Naujan. Boats must anchor about a kilometer from shore, and with no suitable bancas for taking cargo, even slightly rough weather makes unloading impossible. This difficulty has been obviated by the Province of Mindoro purchasing a casco of 33-ton capacity which is towed by the provincial launch, and to a degree solves the transportation problem along the coast.

Part of the materials for the Pinamalayan Central Barrio School (plan No. 7) have been requisitioned. The sand and gravel will be delivered within the next month, it being necessary to get the materials on the ground before the advent of the northeast monsoon, when discharge of cargo is impossible. Pinamalayan being a port open to the full blast of the monsoon, it is expected that the dimension lumber can be secured locally at prices much below Manila figures.

## MISAMIS.

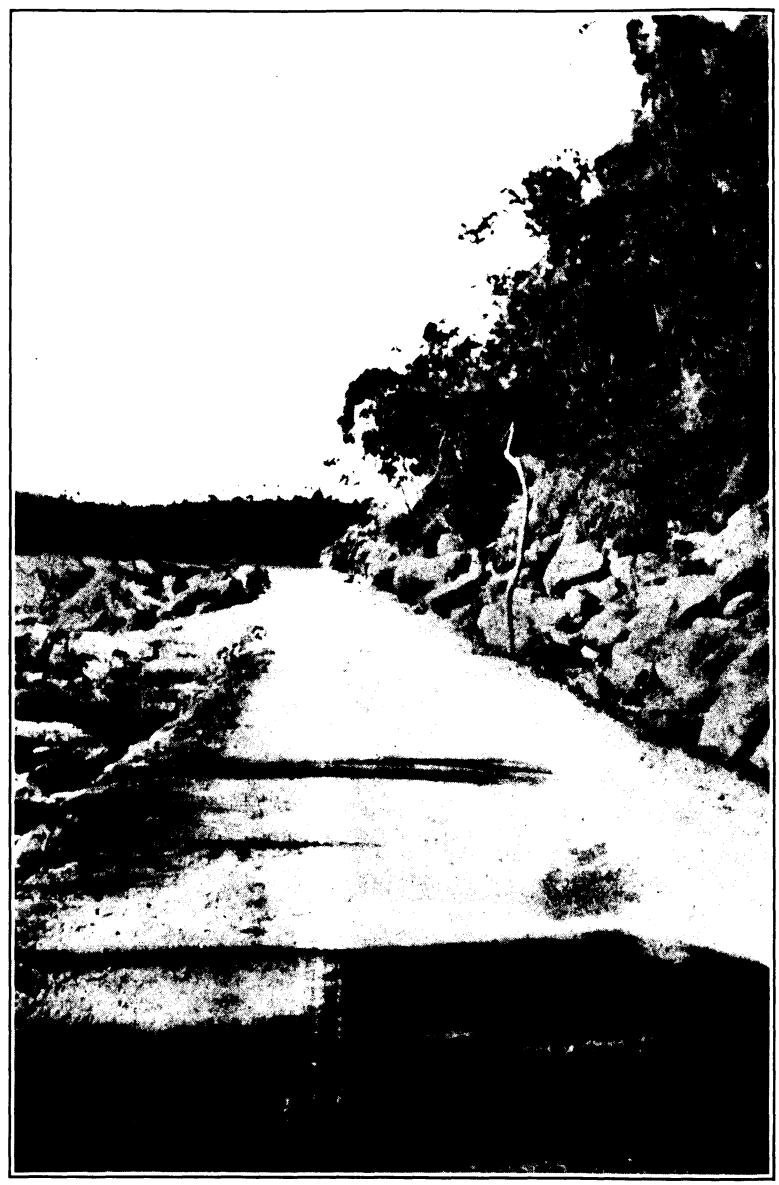
A rock fill has lately been completed across the mouth of Binuni Bay. Two parallel dikes were built of boulders, each dike 1 meter wide on top, with side slopes of ¼ : 1 and ½ : 1 on the inside and outside, respectively. The space between the dikes was filled with blasted hardpan. An improvised floating derrick was used to place the large stones. The tops of the dikes are 0.75 meter above high tide. Two openings spanned by bridges, one of 5 and the other 6 meter span, were built to accommodate the tidal flow. The cost of the causeway, including temporary bridges, was approximately ₱3,500.

Twenty-one kilometers of first-class road on Camiguin Island were constructed during the six-month period ending June 30, 1915.

An earth fill has been constructed across the swampy lands between Tudela and Jimenez on the Misamis–North Road.

Limestone surfacing has been placed on a section of the Tinao–Bukidnon Road. The limestone does not impede traffic, is readily packed by hand or traffic, and once firm remains so during the entire rainy season.

The Philippine Development Company has been using a Young caterpillar traction engine for hauling bridge timbers for the Diklom Bridge on the Malaybalay–Boundary Road. This engine has also proved successful in plowing.



Beach section of telford-base macadam road near Binuni Bay, Camiguin Island, Misamis Province.

## NUEVA ECIJA.

The sum of ₱9,500 has just been received for the construction of a school building, Bureau of Education standard plan No. 6, in the central barrio of San José. This municipality is 44 kilometers from the railroad station at Cabanatuan and half of the distance is over a third-class road. It is estimated that the building will cost ₱15,400.

The schoolhouse at Guimba has just been completed. This building is 2-story wooden structure and has been under construction since 1911, due to lack of funds to complete the building.

The work on the Academic Building at the Central Luzon Agricultural School has been suspended for lack of funds and materials. The students of this school are going to furnish money and labor to complete the building.

The sum of ₱4,500 has been received for the construction of the senior inspector's quarters in Cabanatuan. This building is being constructed from plans made by the district engineer.

Mr. Tan Samco, contractor, has completed a standard 18 by 42 meters market building in Cuyapo and is now constructing concrete tables for the same building.

Work on the market building at Peñaranda is progressing very well and will be completed thirty days ahead of contract time if roofing can be obtained. Mr. Marion E. Martin is the contractor.

Work has just been started on a standard 15 by 39 meters market building at San Isidro. The Manila Lumber Company has the contract for this building for ₱8,420.

Method of constructing the causeway across the Binuni Bay, Camiguin Island, Misamis Province.

Funds have been received for the construction of a standard 18 by 38 meters market building at Guimba and bids will be opened on October 11, 1915.

Work on the substructure of Talavera Bridge is nearing completion. Mr. J. E. Ainsworth is the contractor. The contract for the superstructure has been awarded to Mr. Marion E. Martin for ₱18,916, and the steel has been delivered at Cabanatuan. Work on the erection of the steel will commence as soon as the rainy season is over.

The estimate has been completed for the Pura–Guimba Interprovincial Road, to run from Pura, Tarlac, to the Manila–North Road

Completed rock fill, approximately one-half kilometer long, across the mouth of the Binuni Bay, Camiguin Island, Misamis Province.

just north of Guimba, Nueva Ecija. This road, when completed, will open up a very fertile country.

Funds have just been received for the location and survey of a road from Cabanatuan to the new town site of Vaca and from Vaca to Rizal. This road will open up a new country which is being rapidly populated by emigrants from Ilocos Norte and Ilocos Sur, and will also connect with the Luzon Pineapple Company, which expects to be doing a great business next year in the exportation of pineapples.

Provincial grounds, Cabanatuan, Nueva Ecija.

The construction of the Manila–North Road has been practically suspended during the quarter just closed on account of the rainy season and shortage of funds, but the road has been kept open to traffic excepting on certain sections of new subgrade. At present, however, the road is open for light autos through the entire province.

Provincial grounds, Cabanatuan, Nueva Ecija.

The collapsible bridges at Gapan and Cabanatuan were flooded off in the month of August and no attempt will be made to replace them until the end of the rainy season. Good balsas have been constructed at each place, and no difficulties are encountered in crossing the rivers.

A 10-ton Buffalo-Pitts road roller hauling 15 tons of gravel for maintenance of first-class roads on the Manila–North Road, Province of Nueva Ecija.

The temporary bridges at Talavera and Guimba were washed away at the beginning of the rainy season and balsas have been constructed for crossing the rivers at these places.

### OCCIDENTAL NEGROS.

The surfacing of the Patic–Pulupandan Road has been completed. The road roller used on this work was shipped to Manapla by lorcha and is now working on kilometers 44 and 45 north.

The subgrade of the Victorias–Manapla Road is completed for a distance of 9½ kilometers. Sufficient gravel for the whole road has been delivered on the banks of the Magnanud, Manapla, and Dapdap Rivers, and on kilometers 44 and 45. Hauling will be done by tramway with a petroleum tractor, and bull carts where it is not economical to work the tractor. Two road rollers are now at work, one at each end. With the completion of this section, through traffic between Bacolod and Cadiz will be possible.

The construction of the 3 arch bridges and 20 culverts on the Victorias–Manapla Road is well under way, one 13-meter arch bridge being practically completed and another about half done. The large culverts are also completed.

The plans of the bridge across the Marayo River on the Pontevedra–La Carlota Road have been approved. This bridge is of the same type as the Prize Bridge—that is, of reinforced-concrete pile-and-girder construction with curved wing walls. It is much longer, however, having seven 7-meter spans.

Surfacing work on the La Carlota–La Castellana Road has been delayed, as a road roller is not available for this section at present.

The surfacing of the Hinigaran–Isabela Road has been completed. The progress of the work was rather slow, due to scarcity of labor.

The sum of ₱2,500 has been appropriated for resurfacing 2.7 kilometers of the Isabela–Nalipay Road. This is a second-class road at present, but will be declared and maintained as first class on the completion of the reconstruction.

The reconstruction of the grade on the Himamaylan–Biniquil Road has been discontinued for the present. Work will be resumed after the rainy season. Gravel is being delivered for this section, and surfacing will commence as soon as the weather permits.

Surfacing on the Biniquil–Kabankalan Road is progressing slowly, due to the failure of the gravel contractor to fulfill his contract. A new contract for the delivery and transportation of gravel has been made with a new contractor, so that with favorable weather the road should be completed in October.

The sum of ₱5,000 has been appropriated by the provincial board for the reconstruction of the subgrade of the Kabankalan–Ilog Road, and work will be started as soon as labor is available. Further appropriations will be made next year to surface this section.

Scarcity of laborers is delaying the progress of the construction of the San Carlos–South Boundary Road.

Sufficient funds are available to surface the section between kilometer 61 and the Aguisan River, a distance of 900 meters, and the feeder road into Binalbagan, a distance of 500 meters. This work is about completed.

Insular and municipal funds are available for the construction of a 24-meter market building, type "B," at Bacolod. The plans are expected to arrive soon and the market will then be advertised for bids.

The construction of a market in Maao, a barrio of Bago, was advertised in June, but all bids were rejected and the work by administration has been held up till weather conditions are more favorable, also pending the decision of the municipal council as to the type of structure desired.

The substructure of the Bagacay Bridge across the Binalbagan River into Isabela will be advertised and the contract let by the 1st of the November. Bids for the contract for the new Government central at Isabela were opened September 15 by the central board. It is not yet known whether the work will be done under the supervision of the district engineer or not, but at any rate it will cause an added amount of work for this office as they expect to lay a construction railroad along the provincial road from Hinigaran to the site.

### ORIENTAL NEGROS.

No project notes received.

### PANGASINAN.

Surfacing and grading of the Dagupan–Bayambang Road has been completed to the Malabago River, a distance of 8.4 kilometers. Of this distance only 4.7 kilometers have been declared first class. There remain 4 kilometers of road to be constructed before San Carlos is reached. Investigations and surveys have been finished for bridges over the Malabago and Calasiao Rivers on this road. Investigations have also been completed at bridge sites on the Calasiao—Santa Barbara Road at the Gabon and Toliao crossings.

The Domoloc Bridge, a 5-span reinforced-concrete pile-and-girder structure, has been completed at a cost of ₱10,254.65 and traffic is now passing over it. This bridge was constructed from the ₱15,000 allotted the province in 1914 for the best maintained first-class roads. The balance remaining will be used in the construction of another bridge on the same road.

Investigations and surveys have been completed for a steel bridge across the Agno River at Villasis. It is estimated that ₱300,000 will be need for this structure. The district engineer has recommended nine spans of 160 feet each.

The municipalities of Malasiqui and Urbiztondo have requested loans for the construction of standard presidencias.

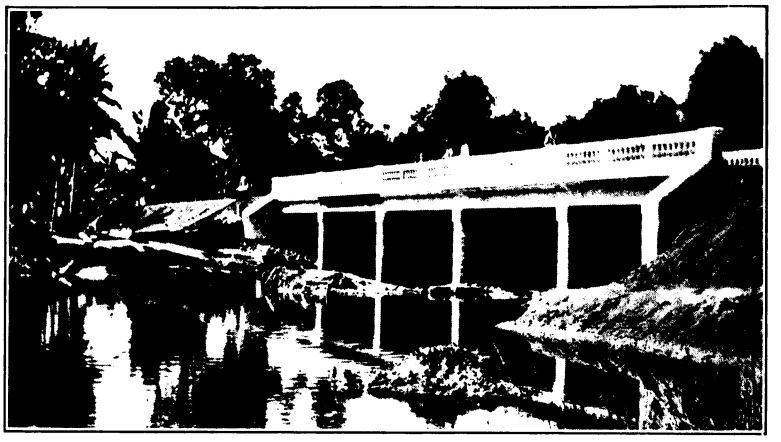
Contractor Tan Samco, of Manila, has completed his contract for the construction of culverts on the Manila–North Road.

Preliminary investigations have been made for a water-supply system for the municipality of Bani.

The Bautista school building was dedicated on September 4. This building is two-thirds of plan No. 7.

The Alaminos, Umingan, and Bolinao school buildings are rapidly nearing completion. It is hoped that they may be dedicated in November.

The provincial board has appropriated ₱500 for the survey of a road connecting Pangasinan with Nueva Vizcaya.



Domolok Bridge, Pangasinan Province.

Investigations are being made for a first-class road from Asingan to San Manuel.

### PAMPANGA.

Work on the Manila–Tarlac Road, San Fernando–Angeles section (16.5 kilometers), was begun on July 1. All grading was completed September 1, and the surfacing is progressing satisfactorily. Most of the grading was done by carabao and bamboo scrapers and resulted in a cost of less than ₱300 per kilometer. In contracting this work the center fills (in centimeters) for each 20 meters were added together and the sum multiplied by ₱10, which gave the price per section. From 40 to 50 per cent was added to the fill for settlement. Where the haul by scraper was too great, a certain percentage up to 100 per cent additional was allowed. This, however, was only necessary for about 250 lineal meters of the road.

This road from a commercial viewpoint is one of the most important in the province and will greatly benefit Camp Stotsenburg in enabling travelers to make the entire trip to Manila from Angeles over first-class roads. Eight kilometers of new right of way were purchased, on which was located a portion of a tangent 9,220 meters long. For the greater part of this distance, the tangent cuts the contours at right angles. The curves on this road are 2° metric or less.

The San Fernando Central School (plan No. 20, less 4 rooms) is about 75 per cent complete. All of the floors, ceiling, partitions, painting, and 25 per cent of the roof are still to be placed.

The Sexmoan School (plan No. 4) has just been started.

The Magalan School (plan No. 6) is well under way. All of the materials, except part of the cement, were on the job before work was commenced.

Work on the Baruya Barrio School (plan No. 3) was suspended pending arrival of the galvanized-iron roofing. This is the only contract school work being done in the province.

The Angeles Market tiendas, consisting of five double 4 by 6 meters and two end tiendas, were completed October 1. The work

was finished in ninety working days, the time estimated to complete the work. The estimated cost was ₱13,686, and the actual cost (certified expenditures and obligations) ₱9,811.65.

The municipality of San Fernando has deposited the sum of ₱13,635.47 with the provincial treasurer and has requested the Consulting Architect to prepare plans for the reconstruction of the old municipal building.

### RIZAL.

Progress on the Pasig Provincial High School has been slow. The building contractor's time has expired. He will not be able to complete the building within two weeks of the required time. The electrical installation, however, has been progressing as rapidly as the unfinished state of the building would permit.

Planting and parking is being carried on during the rainy season in the park around the Antipolo kioskos.

The Taytay Schoolhouse, a 4-room standard plan, has been turned over to the division superintendent of Schools by the contractor. Some grading has been left to be done after the rainy season. The location of the school is on a commanding hill just outside of Taytay on the road to Antipolo. The grounds lend themselves to very attractive parking. The planting of grass and trees and the construction of walks is being held up pending the completion of the grading.

The Parañaque Schoolhouse, a 4-room standard plan with two additional rooms, is well under construction. It should be completed the last of October. Materials on this project are costing approximately ₱9,300 on occount of war-time prices.

A contract has been entered into with John Gordon for the construction of the Navotas Market. Bids have also been received for the construction of market tables according to standard plan concrete table details. The building itself should be completed by the last of October, and the tables a short time thereafter.

The telephone system has been extended to the towns of the Manila–South Road. All municipalities in the province are now connected, 10 being connected directly with the Manila exchange, and the rest with the provincial exchange at Pasig. Construction on the telephone system is still going on, however, consisting in improving old lines and replacing temporary posts with galvanized-steel posts. A line is also being strung to connect the Constabulary post at Novaliches with the Manila exchange.

Three arch bridges are being advertised on the Angono–Binangonan section of the Manila-East Road. These are to take the places of the temporary bridges put in during the construction of the road. It is estimated that these structures will cost about ₱5,000. Grading is progressing slowly on the Binangonan–Cardona section of this road which is an extension of 5 kilometers from the present declared first-class road. An old Spanish location has been followed, except where the road leads down a steep cliff. Here the location has been changed to run along the side of the cliff for about a kilometer, with a maximum grade of 7 per cent.

The Pasig–Taguig and San Juan–San Felipe Nery Roads are being reconstructed as first class. They will be declared on December 31. The Manila–Mariquina Road will also be opened for productive traffic, with the exception of the crossing of the Mariquina River at the end of the road, at which place a temporary structure is maintained during the dry season.

The floor of the Manila Electric Railroad and Light Company's bridge over the Pasig river has been renewed for the municipality. Yacal has been used both for the floor and for the nailing strips.

Progress has been made on the artesian-well program, although not to the extent desired.

Public works expenditures in Rizal for 1915 to the end of August were ₱195,102.57, divided as follows:

| | |
|---|---|
| Road and bridge construction | ₱59,528.81 |
| Road and bridge maintenance | 67,462.80 |
| Building construction and maintenance | 63,455.62 |
| Miscellaneous | 4,655.34 |

### SAMAR.

A 40-ton scow with pockets for sand or gravel, recently completed, will simplify somewhat the question of transportation of materials and machinery in Samar.

The assistance of the district engineer's office was requested by the municipal government of Laoang in preparing plans and constructing a reinforced-concrete water tank for holding rain water. It is hoped that the materials requisitioned will arrive in time to complete same before the end of the rainy season.

Materials have all arrived for the construction of market tables in the Calbayog standard market, and work has begun on same.

The ₱30,000 appropriated by the Legislature for the Calbayog jetty has been received, this being the estimated cost of the jetty only. Dredging will have to be well under way before completing the proposed jetty, as it will close the present channel. An additional ₱50,000 will be required to complete the dredging operations and the concrete coping. Work will be begun as soon as equipment can be secured.

The force at work on the Catbalogan–South Road has been steadily increased and now numbers between 500 and 600 men. Subgrade work on the first 5 kilometers has been entirely finished. This is a mountain side location. Pipe culverts are being installed and about 1 kilometer of surfacing is completed. One 5 by 2 meter standard culvert will be constructed in the vicinity of the provincial building.

The regular Insular allotment heaving been received, subgrade work was begun on the uncompleted section of the Catbalogan–Calbayog Road on September 1. Over 500 men are now employed. It is anticipated that the funds available this year will complete about half of the remaining section and that traffic will be passing through to Calbayog by the middle of next year.

A cut-off section about 7 kilometers long, which will save a distance of 2 kilometers between Laoangan and Pambujan, will be begun this year with provincial funds now available. The early completion of this new section next year will be welcomed by the north-coast people, as two of the worst ferries and many sand dunes will thereafter be avoided. The construction will be of light character.

A standard plan No. 7 school building has been completed at Oras and a standard No. 3 begun at Dolores by Mr. O. Stephens, contractor.

A No. 3 standard plan school building, under construction by administration at Balanguiga, is about finished. People in this historic town have shown an extraordinary interest in their school, and have rendered every assistance.

Provincial funds are on hand for the immediate commencement of a provincial high school in Catbalogan. This will be a standard plan No. 20. It is believed that 16 rooms of the same are all that is possible at present with the funds available.

Standard culvert building on the Borongan–South Road has reached kilometer 11 and has been suspended for this year owing to lack of funds. The completion of two temporary structures and two ferries now under construction will make vehicle transportation possible as far as kilometer 19.

Materials have been assembled for the construction of five standard culverts on the Sulat–South Road. Work has been commenced by Contractor Stephens.

Surfacing operations on the Carangian–Catarman section of the north coast road will be continued up to the end of the year with one steam roller. All the rock has already been delivered on the road. The base will consist of 15 centimeters of coral rock with finger coral for binder. The finished road presents a fine appearance.

### SORSOGON.

Considerable progress has been made in the resurfacing of the Bulan–Irocin Road, the new road roller giving excellent service. The other roads of the province are in their usual condition.

On the Sorsogon–South Road grading has been finished, except for one break of 500 meters, to the barrio of Ventuco, kilometer 29, and surfacing to kilometer 25. The surfacing has been delayed somewhat on account of the continual rains keeping the new grading soft.

Ten of the twelve kilometers on the Donsol–Pilar Road have been completed.

The Bacon Market is now 40 per cent completed. The labor is being furnished by contract by Mr. Pedro Garra for ₱2,600, and the materials by the Government.

Work has just been started on the new provincial building by Mr. B. F. Mills, who contracted the job for ₱71,300. No bids were accepted for the jail and courthouse, and that building is now under construction by administration.

The Gubat–Bulusan Road was completed in July, and regular auto service is now operating between those towns.

A second artesian well, pumping 15 gallons per minute, has been finished in Irocin.

### MASBATE.

Heavy rains and the steady heavy traffic have somewhat damaged the Aroroy roads, but they are being repaired.

Progress has been slow on the continuation of the Lumbang–Milagros Road, on account of labor not being as plentiful as was expected.

Work has been started on both ends of the San Jacinto–San Fernando Road in Ticao, and about 3 kilometers of grading are completed. Fifty per cent of the funds for this road was furnished by the two towns.

## SULU.

Heavy maintenance and repair work is continueing over the Maibong and Parang Roads.

Frank & Vicroy, contractors, have just finished distributing 3,000 cubic meters of coral over 6 kilometers of the Maibong Road. A 5-ton White truck was used for this purpose.

Standard kilometer posts are being made and placed on the Maibong and Parang Roads.

The telephone line from Jolo to Siet Lake, a distance of 35.54 kilometers, has been completed. Communication was opened September 10. The line will be continued to Camp Andres, approximately 14 kilometers farther.

September 5 was the date set for opening bids on the Lapac school building and cottage. As no bids were received, the work will be done by administration. The amount appropriated is ₱16,000. The school building is a standard plan No. 6, revised for timber construction above piers, which are of concrete. Roofs are identical with standard plan. The teacher's cottage is of a similar type of construction, with 6 rooms and a veranda. All iron and hardware have been ordered.

The Sulu Public Hospital will be completed by October 10.

The Cagayan Dock will be completed by the end of October.

## SURIGAO.

No project notes received.

## TARLAC.

The following Bureau of Education plan No. 2 schools are now completed and ready for occupancy:

| | |
|---|---|
| Balincanauay School | ₱4,249.98 |
| Calibangbang School | 4,054.81 |
| Sinilian School | 4,273.58 |

The followings are under construction at present:

Nipaco, Bureau of Education plan No. 2 school.
San Manuel, Bureau of Education plan No. 4 school.
Bamban, Bureau of Education plan No. 4 school.

The work on the Tarlac–La Paz Road is going on, although rather slowly at present, due to weather conditions. The grading on this road was completed several months ago and therefore the work at present consists in building the necessary culverts and the metaling.

Young mango trees in the Tarlac nursery, grown from seeds in bamboo joints for roadside planting.

The latter is completed on kilometer 8 and half of kilometer 9, the first and second courses on the rest of kilometer 9, and the first course on kilometer 10 as far as station 10+400.

On the Pura–Nueva Ecija Boundary Road, the grading is completed and metaling will be started as soon as the rainy season is over, probably by November 1. This road strikes the Manila–North Road at station 155+706 thereon. The road goes through level country and the location is a single tangent of 11.75 kilometers, probably the longest highway tangent in the whole Archipelago.

## TAYABAS.

Construction of a plan No. 7 school building has been begun at Infanta. The town is situated about 2½ kilometers from the sea on the great delta and nipa swamp at the mouth of the Agos River, and is very nearly due east from Manila. Materials from Manila are transported by steamer to the mouth of the river, where they are transhipped to bancas and towed up the river to the Misua Road, over which they are hauled 2 kilometers by bull carts to the site. The river practically ceases at the beginning of the nipa swamp and the uninitiated would have difficulty in choosing the correct channel from among the maze of waterways traversing the entire delta. While the cost of this structure will necessarily be greater than for similar work under more favorable conditions, it is expected that the previous training and experience of the men employed will materially cut down labor charges.

The necessity for continuous gaging of the flow of all streams or springs which might possibly be utilized for hydraulic power or water-supply purposes has been forcibly brought to the attention of all who have followed the development of the Lucban hydroelectric project. The water supply for this company's plant is obtained from a spring on the side of Mount Banahao. The flow fell off 75 per cent during the southwest monsoon. The spring flow at Tayabas and Sariaya fell off in like proportion during this period, indicating that all the springs on Mount Banahao are fed by the lake in the old crater. Investigations are now being made to determine the range of fluctuations of flow to be expected at these springs. That ample funds should be provided for preliminary investigations has been proved by experience, and failure to provide for such investigations fixes the responsibility for many engineering disasters.

The provincial building at Lucena is now undergoing repairs. The pitch of the U-shaped gutters as constructed was insufficient to carry off all the water, and the standing water had corroded the sheet iron so badly that the entire gutter had to be replaced. Anay have attacked whatever soft wood they can reach, one of the most curious instances of their activity having been noted in the flooring. The second-story floor is of concrete, with nailing strips embedded therein, to which the hardwood floor is nailed. Anay are attacking the nailing strips, which renders it very difficult to combat them. In laying the first floor of a concrete building, especial care should be taken to secure a tight joint at the walls, as it has been found that anay will follow and work their way through a remarkably small crack in a concrete or tile floor.

The municipality of Lucena has requested plans and estimates for a midden shed and temporary water supply for their market plant.

Great activity has been noted in the construction of private buildings in Lucena. The section swept by the fire of September 19, 1913, is now being rapidly built up with stores and houses of substantial materials. Fire-resisting roofing is universally used.

The municipal presidents of a number of isolated towns, at the request of this office, are now expending Act No. 1932 funds accruing to their respective municipalities, as the amounts available do not warrant sending a foreman out for the purpose.

Tayabas–Lucban Road construction has reached kilometer post 19 and is progressing satisfactorily. Continuous rain has greatly hindered the work, but the traveling public has thus far been able to use the road for all but a very short period. Construction has now reached the highest elevation on the entire route, about 1,500 feet above the sea. Large quantities of boulders have been encountered and much ground water. A Buffalo-Pitts roller is being used on this work and has been able to work on heavy grades in a satisfactory manner. Subgrade work is being done by the *pakyaw* system at economical prices, payment being made at an agreed price per lineal meter of roadway, the price depending on the amount of work involved.

Sariaya Matadero, 12 by 25 meters, has been completed by the contractor, Mr. Tan Samco, of Manila, at a total cost, excluding surcharges and extra work, of ₱7,548. The building is well constructed and will serve the needs of the town for many years to come. The eight standard 4 by 4 meters double tiendas are practically completed, only the painting and installing of door-locking devices remaining uncompleted.

Construction of Panaon (railroad station) Unisan Road has progressed satisfactorily during the quarter. One-half of the grading has been completed. This road is located through swamp land and the work has been rendered difficult because of the clearing required. A wide detour was necessary in locating this road to avoid the many bends of the Kalilayan River. In obtaining gravel for surfacing, the contractor is obliged first to fence off the gravel beds in the river to prevent the approach of crocodiles, otherwise the workmen refuse to enter the water. It is reported that large specimens of this animal infest the waters of Kalilayan River.

Road maintenance has been carried on as usual. Several kilometers of road have been extensively repaired. It is now evident, however, that gravel is unsatisfactory as construction and maintenance material, owing to the difficulty of obtaining proper sizes and also to the high cost. It is hoped that a quarry can be developed to provide suitable crushed rock for road purposes. The heavy rains have kept the maintenance forces busy on shoulder maintenance, but so far have not caused any damage to surfacing.

A large pearling fleet from Jolo and the Sulu fields is now operating among the Polillo group of islands. It is reported that very good shell

in limited quantity is being found at a working depth of 42 fathoms. These boats are very seaworthy and are fitted with diving apparatus of the most modern type. Japanese and a few Filipinos, Moros, and Malays do the diving on a percentage basis.

Construction of a plan No. 6 school building has been authorized at Tiaong. The sum of ₱13,000 is available and the project is now being advertised.

### MARINDUQUE.

The construction of Mogpog school building, a standard plan No. 6 structure, has been completed after a very considerable delay due to lack of funds. Voluntary contributions by various public spirited citizens of the town made possible the completion of the work.

Bids for construction of bridge No. 16.1, Boac–Gasan Road, have been opened, and the awarding of the contract is now under consideration. This is to be a concrete pile-bent structure of six 9-meter spans, with ornamental balustrades and lamp-posts. The donation of the land necessary for the approaches to the bridge site has materially aided in making construction possible at this time.

Bamboo floating bridges are provided at the river crossings at Boac and Gasan to permit automobile traffic to pass with ease. Wheeled traffic is developing on the newly completed Buenavista section of the Boac–Gasan Road, which materially assists in keeping the road in shape, as the gravel is very hard and requires considerable binder.

### ZAMBALES.

During the quarter, three rectangular culverts were completed near Santa Cruz. Another 3 by 2 meters culvert is under construction in the same vicinity.

In some cases it has been found economical in this district to filll in some of the smaller tidal streams located near larger ones by diverting the former to the latter above the road, rather than by constructing concrete structures.

All materials for the Subic water supply have been received. The excavation for the concrete tank has been completed. Most of the material excavated was hard rock and had to be blasted. It is expected that the system will be completed by next October.

Plans for the new diversion road between Amungan, Iba, and San Lorenzo, Masinloc have been duly approved. The maximum grade will be 6 per cent. Work will be started on the construction of a pack trail on the new location just as soon as the necessary money is appropriated.

The following surveys were made during the quarter: three steel bridges at Anunang, Cabangan, and Kiling Rivers, all between Iba and Subic; relocation survey on the south side of Subic Hill; survey for a pile bridge at the Lucapon River near Santa Cruz.

Due to the failure of the deep-well rig to obtain good artesian water at Iba, it is thought that shallow tubular wells driven about 22 feet will bring far better results than the old unsanitary open wells. The cost of a 2-inch well of galvanized-iron pipe in place and fitted with an ordinary suction pump is about two-thirds as much as the tile well 2 feet in diameter most commonly used by the people. The 2-inch well is suitable in all the coast towns of the province, as the soil formation is sandy. Several wells have already been driven by the people in each of the following towns with good results: San Antonio, San Narciso, San Felipe, and Iba. Two wells will be driven for the municipality of Palauig as soon as the standard suction pumps ordered from the Bureau are received.

The water from the artesian well at Botolan has proved to have medicinal properties of a decidedly laxative nature, so that many people of the town and from the surrounding towns are now using the water on this account.

### ZAMBOANGA.

Plans and estimate have been prepared for a concrete addition to the present city hall to provide additional office space and quarters for the police department. Owing to lack of funds this work will probably not be undertaken until after January 1.

A water system for the provincial high school grounds and gardens has been completed and temporarily connected with the overflow from the Zamboanga ice plant. A head of 45 feet was obtained which provides sufficient pressure at the hydrants for watering the grounds with a hose. The system can easily be connected with the street mains upon the completion of the Zamboanga waterworks system.

The remodeling of Plaza General Pershing was undertaken September 1 and is at present well under way. The plans for this work include the construction of a concrete roof to the present band stand with concrete flower urns and roof garden; two concrete arches at the main entrances to the plaza, and six iron arches to be covered with flowering vines; a serpentine coral walk around the plaza, bordered with shrubs; concrete benches and flower urns; and a marine rock fountain and water pool at either end of the plaza.

Construction work on the Zamboanga–East Coast Road has progressed very satisfactorily in spite of threatened labor difficulties. In order to hold the Moro laborers it became necessary to inaugurate a new system of payment whereby the men receive 40 centavos per day and subsistance. From 150 to 250 men were employed continuously during the quarter on grading work. The grading has now reached kilometer 19 and the gravel surfacing has been placed as far as kilometer 17. At station 16+200 a standard 5 by 3 meters concrete culvert was constructed over Culianan Creek.

The installation of the Zamboanga–telephone system was completed August 31. The system comprises 85 modern automatic telephones within the city limits, and lines to the adjacent towns of Tetuan, Mercedes, Recodo, and San Ramon Penal Farm. The lines are at present being extended to include the towns of Manicahan, Bolong, Curuan, Santa Maria, and the waterworks camp. In addition, two trunk lines to the military exchange give direct connection with the 45 telephones carried on that system. The new system is owned and operated by the province.

During June and July extensive investigations and surveys were made along the Tumaga River, which proved the advisability of making certain changes in the original waterworks plans. The present plans call for approximately 9,000 feet of 30-inch reinforced-concrete pressure pipe and 1,580 feet of tunnel section between the intake and distributing reservoir, instead of the open flume as previously planned. Tunnel excavation was begun September 9, and active construction of the pipe line will start upon the arrival of the Hy-Rib reinforcing steel ordered for this work. The first shipment of this reinforcing, which is manufactured by the Trussed Concrete Steel Company, of Detroit, Michigan, is expected to arrive in October.

Early in July an attempt was made to dredge Zamboanga Harbor at the end of the present wooden pier to a depth of 26 feet at mean low tide, with the idea of allowing the Japanese liners touching at Zamboanga to come alongside the pier. The orange-peel dredge owned by the province was found to be in such an unserviceable condition that it could not be used economically or with safety on this work. The material to be removed was composed entirely of sand and dead coral, having a decided slope to deep water. As the current through the Basilan Straits is very strong just beyond the pierhead, a scheme was devised for washing or sluicing out the sand and finger coral by means of the municipal fire engine, a 40-horsepower, 4-cylindergasoline engine manufactured by the Waterous Engine Works Company, of St. Paul, Minnesota. A diver with diving suit was used to handled a 1-inch fire nozzle on the harbor bottom. Difficulty was experienced at first from the fact that the diver could not handle the nozzle when under full engine pressue. This was overcome by attaching the hose to an anchor a short distance from the nozzle and moving the anchor from time to time as the sand was worked from the pier toward deep water. Sand and coral to a depth of from 5 to 8 feet was removed by this method from the entire area in front of the pier and sluiced out into deep water, the current carrying the light material for a considerable distance when once started. The work was completed in fourteen working days, the diver averaging six hours per day under water.

## FINANCIAL.

### APPROPRIATIONS AND ALLOTMENTS, FISCAL YEAR 1915.

No allotments have been made since our report of July 1, 1915.

### LOANS FOR ROADS, BRIDGES, SCHOOLS, MARKETS, ETC., FROM JULY 1, 1915, TO SEPTEMBER 30, 1915.

| Provinces and projects. | Acts Nos. | | Total. |
|---|---|---|---|
| | 1749. | 1729. | |
| Antique: For the purchase of the site and building to be used for provincial and municipal offices | ₱20,000 | | ₱20,000 |
| Batangas: San José market | 10,000 | | 10,000 |
| Cavite: For the purpose of constructing a bridge over the Cañacao Estero on Calle Salamanca, at Cavite | | 10,000 | 10,000 |
| Ilocos Sur: For the purpose of completing the installation of the "Singson Waterworks system" at Vigan | 5,000 | | 5,000 |
| Nueva Ecija: Guimba municipal building | | 1,000 | 1,000 |
| Occidental Negros: For the purpose of constructing a bridge over the river between Hinigaran and Isabela | | 55,000 | 55,000 |
| Pampanga: Guagua market | | 2,500 | 2,500 |
| Pangasinan: Manaoag market | 18,000 | | 18,000 |
| Surigao: Surigao-Sison Road | 30,000 | | 30,000 |
| Tayabas: Pagbilao market | 15,000 | | 15,000 |
| Total | 98,000 | 68,500 | 166,500 |

### ANTIQUE.

For the purpose of purchasing from the municipality of San José the site and building at present used jointly by the provincial and municipal governments for the provincial and municipal offices, a

loan of ₱20,000 is hereby granted the Province of Antique, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1749. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱2,000 | ₱800 |
| Second | 2,000 | 720 |
| Third | 2,000 | 640 |
| Fourth | 2,000 | 560 |
| Fifth | 2,000 | 480 |
| Sixth | 2,000 | 400 |
| Seventh | 2,000 | 320 |
| Eighth | 2,000 | 240 |
| Ninth | 2,000 | 160 |
| Tenth | 2,000 | 80 |

BATANGAS.

For the purpose of purchasing a site and erecting modern market buildings thereon, a loan of ₱10,000 is hereby granted the municipality of San José, Province of Batangas, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1749. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱1,000 | ₱400 |
| Second | 1,000 | 360 |
| Third | 1,000 | 320 |
| Fourth | 1,000 | 280 |
| Fifth | 1,000 | 240 |
| Sixth | 1,000 | 200 |
| Seventh | 1,000 | 160 |
| Eighth | 1,000 | 120 |
| Ninth | 1,000 | 80 |
| Tenth | 1,000 | 40 |

CAVITE.

For the purpose of constructing a bridge over the Cañacao estero on Calle Salamanca in the municipality of Cavite, a loan of ₱10,000 is hereby granted the Province of Cavite, payable in five equal annual installments due in three, four, five, six, and seven years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1729. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱2,000 | ₱400 |
| Second | 2,000 | 320 |
| Third | 2,000 | 240 |
| Fourth | 2,000 | 160 |
| Fifth | 2,000 | 8 |

ILOCOS SUR.

For the purpose of completing the installation of the "Singson waterworks system" in the municipality of Vigan, a loan of ₱5,000 is hereby granted the municipality of Vigan, Province of Ilocos Sur, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1749. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱500 | ₱200 |
| Second | 500 | 180 |
| Third | 500 | 160 |
| Fourth | 500 | 140 |
| Fifth | 500 | 120 |
| Sixth | 500 | 100 |
| Seventh | 500 | 80 |
| Eighth | 500 | 60 |
| Ninth | 500 | 40 |
| Tenth | 500 | 20 |

NUEVA ECIJA.

For the purpose of completing the construction of its Municipal Building, a loan of ₱1,000 is hereby granted the municipality of Guimba, Province of Nueva Ecija, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum

| Payments. | Act No. 1729. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱100 | ₱40 |
| Second | 100 | 36 |
| Third | 100 | 32 |
| Fourth | 100 | 28 |
| Fifth | 100 | 24 |
| Sixth | 100 | 20 |
| Seventh | 100 | 16 |
| Eighth | 100 | 12 |
| Ninth | 100 | 8 |
| Tenth | 100 | 4 |

OCCIDENTAL NEGROS.

For the purpose of constructing a bridge over the Binalbagan River, on the road between Hinigaran and Isabela, a loan of ₱55,000 is hereby granted the Province of Occidental Negros, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per centum per annum.

| Payments. | Act No. 1729. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱5,500 | ₱2,200 |
| Second | 5,500 | 1,980 |
| Third | 5,500 | 1,760 |
| Fourth | 5,500 | 1,540 |
| Fifth | 5,500 | 1,320 |
| Sixth | 5,500 | 1,100 |
| Seventh | 5,500 | 880 |
| Eighth | 5,500 | 660 |
| Ninth | 5,500 | 440 |
| Tenth | 5,500 | 220 |

PAMPANGA.

For the purpose of completing the present modern market building by installing modern sanitary tables therein, a loan of ₱2,500 is hereby granted the municipality of Guagua, Province of Pampanga, payable in three annual installments due in one, two, and three years, respectively, from the date of the loan, together with interest payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1729. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱850 | ₱100 |
| Second | 850 | 66 |
| Third | 850 | 32 |

PANGASINAN.

For the purpose of purchasing a market site and erecting modern market buildings thereon, a loan of ₱18,000 is hereby granted the municipality of Manaoag, Province of Pangasinan, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1749. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱1,800 | ₱720 |
| Second | 1,800 | 648 |
| Third | 1,800 | 576 |
| Fourth | 1,800 | 504 |
| Fifth | 1,800 | 432 |
| Sixth | 1,800 | 360 |
| Seventh | 1,800 | 288 |
| Eighth | 1,800 | 216 |
| Ninth | 1,800 | 144 |
| Tenth | 1,800 | 72 |

SURIGAO.

I have to request that the communication of His Excellency the Governor-General, dated November 6, 1914, granting a loan of ₱30,000 to the Province of Surigao for the purpose of constructing the Surigao–Sison Road, be amended, effective one year from the date the funds were placed to the credit of the provincial treasurer, to read as follows:

"For the purpose of constructing the Surigao–Sison Road, a loan of ₱30,000 is hereby granted the Province of Surigao, payable in two equal annual installments due in three and four years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum."

| Payments. | Act No. 1749. | |
|---|---|---|
| | Principal. | Interest. |
| 1915 | | ₱1,200 |
| 1916 | | 1,200 |
| 1917 | ₱15,000 | 1,200 |
| 1918 | 15,000 | 600 |

TAYABAS.

For the purpose of purchasing a site and erecting modern market buildings thereon, a loan of ₱15,000 is hereby granted the municipality of Pagbilao, Province of Tayabas, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

| Payments. | Act No. 1749. | |
|---|---|---|
| | Principal. | Interest. |
| First | ₱1,500 | ₱600 |
| Second | 1,500 | 540 |
| Third | 1,500 | 480 |
| Fourth | 1,500 | 420 |
| Fifth | 1,500 | 360 |
| Sixth | 1,500 | 300 |
| Seventh | 1,500 | 240 |
| Eighth | 1,500 | 180 |
| Ninth | 1,500 | 120 |
| Tenth | 1,500 | 60 |

## SELECTED.

### BLUE LAWS FOR ENGINEERS.

(Code of Hammurabi, King of Babylon, about 2250 B. C.)

If a builder build a house for a man and do not make its construction firm, and the house which he has built collapse and cause the death of the owner of the house, that builder shall be put to death.

If it cause the death of a son of the owner of the house, they shall put to death a son of that builder.

If it cause the death of a slave of the owner of the house, he shall give to the owner of the house a slave of equal value.

If it destroy property, he shall restore whatever it destroyed, and because he did not make the house which he built firm and it collapsed, he shall rebuild the house which collapsed at his own expense.

If a builder build a house for a man and do not make its construction meet the requirements and a wall fall in, that builder shall strengthen that wall at his own expense.

If a builder build a boat for a man and he do not make its construction seaworthy and that boat meet with a disaster in the same year in which it was put into commission, the builder shall reconstruct that boat and he shall strengthen it at his own expense and he shall give the boat when strengthened to the owner of the boat.

If a man neglect to strengthen his dyke and do not strengthen it, and a break be made in his dyke and the water carry away the farmland, the man in whose dyke the break has been made shall restore the grain which he has damaged.

If he be not able to restore the grain, they shall sell him and his goods, and the farmers whose grain the water has carried away shall share (the results of the sale).

If a man open his canal for irrigation and neglect it and the water carry away an adjacent field, he shall measure out grain on the basis of the adjacent fields.

—(*Harper's Edition.*)

# APPENDIX A.

## CIRCULAR LETTERS ISSUED BY THE CONSTRUCTING DIVISION FROM JULY 1, 1915, TO SEPTEMBER 30, 1915.

MANILA, P. I., *July 15, 1915.*

*Constructing Division Circular No. 156.*

SIR: Your attention is invited to the following excerpt from the present (bridge) specifications on the testing of concrete:

"130. Immediately after the delivery of cement, sand, and gravel (or broken stone), at the bridge site, and at least two weeks in advance of the placing of any concrete, a set of three sample cubes each of Class A and Class C concrete shall be made * * * and * * * sent to the Manila office for testing in compression. * * * (1,600 pounds per square inches is expected, for Class A concrete).

"131. From time to time sample cubes of concrete actually used in the structure shall be made, at least one sample (one set) for every 10 (20 on large work) cubic meters of all Class A concrete and Class C concrete used in (reinforced) retaining walls, spandrel walls, and curbs; also at least one cube of Class C or D concrete of that portion of the abutment adjoining or abutting the Class A concrete in arch rings.

"132. All cubes shall be legibly marked, giving class of concrete, date of mixing, and position occupied in the structure.

"133. After the sample concrete has been poured into the molds, said molds shall be stored away and the concrete kept therein twenty-four hours before the molds may be stripped. Such stripping shall be done in a careful manner so as to not damage the cubes. The cubes shall then be seasoned under fresh water for thirteen days, when they shall be sent to the Manila office for testing.

"134. The results of the tests implied by the above paragraphs shall be used as a further guide for the proportioning of the various classes of concrete, and for the time allowed in which to remove forms around said concrete."

It will be noted that paragraph 133 differs from the present printed specification in the matter of seasoning of samples. As this is purely an administrative matter, in that the new procedure will produce better samples than the old, the contractor will not be concerned.

It is expected that these specifications will be observed on contract and *on administration work* as well. Samples in about the same number must be submitted on all concrete work other than bridges done by the Bureau of Public Works.

The procedure will be as outlined below:

*Number of specimens to be made.*—Where "sample" has been used in the foregoing, it is understood to mean a *set* of specimens. Three specimens will be taken in each set. One of these will be broken on the job, to afford the engineer a chance to study the results he is getting. The remaining two will be forwarded to Manila as soon as after the fourteen-day seasoning period as possible. It is desired to test these at twenty-eight days after casting, hence expedition in shipping samples is necessary.

*Making, seasoning, and shipping samples.*—Forms should be as nearly true as is possible. (Cast-iron form for test specimens of the dimensions recommended by the joint committee, which it is intended to introduce in the near future, is shown by the print inclosed. Quotations are being secured on these and district engineers will be advised as to the price secured. Each province should have one set for each job carried on at the same time.)

Concrete should be representative of the job. On account of the small size of the specimen in comparison with the form boxes on the job, more care in spading to eliminate voids will be necessary. Care should be taken to get as smooth surfaces as possible. The forms should be coated with a light oil (kerosene will answer) to prevent adhesion of concrete. The bottom should be cast on a smooth plank, and the top lightly troweled. Parallel and smooth faces are requisite for reliable tests. The serial number and date should be scratched on the top of the specimen. After casting, cover forms with wet burlap, canvass, grass, or other material to protect them from the sun, and leave undisturbed for twenty-four hours. The air surrounding the specimens should be as moist as possible during this period. At the end of twenty-four hours, the forms are to be carefully removed, and the specimens stored *under fresh water* for thirteen days, then carefully packed in straw in strong boxes, and sent to Director of Public Works, Manila.

*Data, letter of transmittal, etc.*—Data will be entered on Form No. 304, as indicated by the attached sample copy. All data outlined to be furnished. Three copies of Form No. 304 will be sent to the Director of Public Works. The engineer will retain the thin paper copy.

Separate cards shall be made for *each class of concrete, and for each job.* The fullest information possible should be given to the end that the results secured may be of maximum value to the Bureau at large.

Attach to the three cards the bill of lading, and mail *without letter of transmittal.*

*Filing tests.*—After the tests are made, results are entered on the reverse side. One card will be retained by the Bureau of Science, one by the Bureau of Public Works Library, Manila, and the third will be returned to the engineer. It is highly desirable that these tests be kept at hand for ready reference, for which a Globe-Wernicke No. 258 C. I. file (for 5 by 8-inch cards) is recommended. It is intended to standardize the procedure in Bureau of Public Works tests of *all* engineering materials, so that reports will be of uniform size. This will be done as rapidly as conditions permit, the anticipated number and value of the reports augments the necessity for such a file.

For the Director:

C. E. GORDON,
*Acting Chief Constructing Engineer.*

To all SENIOR SUPERVISING ENGINEERS,
DISTRICT ENGINEERS,
CIVIL ENGINEERS ON SPECIAL DUTY,
CITY ENGINEER, *Baguio*, and
Mr. CATON.

B. P. W. FORM 304. [Front.]

BUREAU OF SCIENCE.

*Data on concrete submitted for testing.*

Date submitted: *June 22, 1915.*

Project: Blank Bridge (girders and slabs).
Province: Pangasinan.
Town: Dagupan.
Submit charge to provincial treasurer, Lingayen, Pangasinan.
Engineer: John Jones.
Contractor: Smith & Co.
Cubes: No. Submitted: 6.
Dimension: 6 inches.
Cylinders: No. Submitted: None.
Diameter: ——
Height: ——
Consistency of mix (dry, wet, puddled): Wet.
Mixing (hand or machine): Hand.
Brand of cement: Universal.
Proportion by volume: 1: $1\frac{3}{4}$: $4\frac{1}{2}$.

Water used in mixing concrete (clear or muddy, sea or fresh, running or stagnant, river, spring, or lake): Fresh, running, from Agno River; clear.

| Date of mix. | Specimen No. | | Date of mix. |
|---|---|---|---|
| 6/1/15 | 13 | 19 | 6/8/15 |
| 6/1/15 | 14 | 20 | 6/8/15 |
| 6/4/15 | 16 | | |
| 6/4/15 | 17 | | |

Sand: Very fine, medium, coarse: Medium.
Clean, dirty: Has 5 per cent clay.
Beach, river, pit, coral, shell, rock screenings: River; from Agno River.
Stone: Gravel from Agno River.
Large, small, graded: Graded.
Hard, soft: Hard.
Clean, dirty: Clean.

[Reverse.]

Request No.....

BUREAU OF SCIENCE.

*Concrete compression test.*

Report to .....

*Manila, P. I.,* ....., *191*.....

| Mark on specimen. | Proportions by volume. | Age in days. | | | Area of breaking surface (square inches). | Unit strength in pounds per square inch. | | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | In moist air. | In water. | In air. | | First crack. | Ultimate. | |
| 13 | ----- | 1 | 13 | ----- | ----- | ----- | ----- | ----- |
| 14 | ----- | 1 | 13 | ----- | ----- | ----- | ----- | ----- |
| 16 | ----- | 1 | 13 | ----- | ----- | ----- | ----- | ----- |
| 17 | ----- | 1 | 13 | ----- | ----- | ----- | ----- | ----- |
| 19 | ----- | 1 | 13 | ----- | ----- | ----- | ----- | ----- |
| 20 | ----- | 1 | 13 | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |

Charges ₱..... .....

MANILA, *July 15, 1915.*

*Constructing Division Circular No. 157.*

SIR: Your attention is invited to the attached "standard specifications for concrete materials and proportioning," which supersede paragraphs 70 and 117 to 126, inclusive, "specifications for bridges of concrete and reinforced concrete," on all future bridge work, and which are included in all building specifications, issued since May 15, 1915.

Attention is also invited to "cement tests—interpretation of results," copy of which is attached hereto.

For the Director:

C. E. GORDON,
*Acting Chief Constructing Engineer.*

To all SENIOR SUPERVISING ENGINEERS,
DISTRICT ENGINEERS,
CIVIL ENGINEERS ON SPECIAL DUTY,
CITY ENGINEER, *Baguio,* and
Mr. CATON.

## STANDARD SPECIFICATIONS FOR CONCRETE MATERIALS AND PROPORTIONING.

### CEMENT.

(1) Cement shall meet the requirements of the United States Government specifications for Portland cement, as promulgated by the President of the United States on April 30, 1913, except that section 24 shall be as modified by the Government of the Philippine Islands, it being necessary to make tests at a somewhat higher temperature than 21° C. (70° F).

The requirements of these specifications are briefly as follows:

*Composition.*—Loss on ignition for fifteen minutes, not to exceed 4 per cent; insoluble residue, not to exceed 1 per cent; sulphuric anhydride ($SO_3$), not to exceed 1.75 per cent magnesia (MgO), not to exceed 4 per cent.

*Specific gravity.*—Not less than 3.10.

*Fineness.*—Ninety-two per cent, by weight, to pass a No. 100 sieve and 75 per cent to pass a No. 200 sieve.

*Soundness.*—Pats of neat cement to remain firm and hard and show no signs of distortion, checking, cracking, or disintegrating under the following tests: (*a*) Kept in moist air for twenty-four hours and in air for twenty-eight days; (*b*) kept in moist air for twenty-four hours and in water for twenty-eight days; (*c*) kept in moist air for twenty-four hours and exposed to steam at atmospheric pressure above boiling water for five hours.

*Time of setting.*—Initial set in not less than forty-five minutes; final set in not more than ten hours.

*Tensile strength.*—Neat cement briquettes: After seven days, 500 pounds per square inch; after twenty-eight days, 600 pounds per square inch. Briquettes made of 1 part cement and 3 parts Ottawa sand, by weight: After seven days, 200 pounds per square inch; after twenty-eight days, 275 pounds per square inch.

(2) Samples shall be taken from at least 1 barrel in every 10 from each lot delivered. Each sample shall be tested separately, every fourth sample only being tested for specific gravity, fineness, soundness, and time of testing.

(3) Failure to pass the twenty-eight days' tensile strength test of either neat cement or mortar briquettes, any retrogression in strength from seven to twenty-eight days in either neat cement or mortar briquettes, or failure in normal soundness test will be cause for rejection. If the accelerated soundness test prove unsatisfactory, the cement will be held for the twenty-eight days' test; and in case of failure in both normal and accelerated test, a retest may be made, provided all other tests are satisfactory. If the tensile strength exceeds the specified minimum by 10 per cent, the requirements for fineness and specific gravity may be waived.

(4) Failure of more than 10 per cent of the samples tested from any lot, except as noted in paragraph 3 in respect to fineness and specific gravity, or the failure of any single sample in soundness, or by more than 15 per cent in tensile strength, or showing retrogression in neat or mortar strength from seven to twenty-eight days, shall be taken as indicating lack of uniformity in the shipment and the entire shipment will be rejected. The contractor, if he so desire, may have each barrel of a lot so rejected retested, in which case each barrel will be accepted or rejected on its own test.

(5) All tests shall be at the expense of the contractor.

(6) Cement shall not be used except it has been tested and written authority obtained to use same.

(7) Cement shall be delivered at the site in tight wooden barrels or sealed drums and shall be stored in such manner as to be off the ground and protected from inclement weather. Storage and protection shall be subject to the approval of the Director. Cement damaged after testing will not be allowed in the work.

### FINE AGGREGATE.

(8) Fine aggregate used in the composition of concrete, mortar, grout, or plaster shall be hard, clean, entirely free from loam and vegetable matter, or foreign substances adhering to the surface of the grains or cementing them together, and shall not contain more than 5 per cent of clay. For the exposed work, it shall be free from any substance which will discolor the concrete surface. A graded mixture with only a small percentage of fine particles (100 per cent passing a No. 4 screen and at least 60 per cent held on a No. 20 screen) will be required. The Director may, at his discretion, require washing or screening.

### COARSE AGGREGATE.

(9) The coarse aggregate shall be either crushed stone or gravel composed of hard, sound particles, free from foreign substances adhering to their surfaces, clay, loam, fine sand, or crusher dust. Soft stone or stone having a distinct cleavage will not be allowed. The mixture shall be well graded as to size, ranging from 0.6 centimeters (¼ inch) up to the maximum size specified for each class of work. The Director may, at his discretion, require screening or washing.

### TESTING OF AGGREGATES.

(10) If the suitability of either fine or coarse aggregate has not been established by test of materials from the same locality, the contractor shall submit to the Director samples for testing. Samples shall consist of not less than 0.10 cubic meter, and shall be submitted at least three weeks before it is proposed to use the material in question.

### WATER.

(11) Water used in gauging concrete shall be free from organic substances and reasonably clear. Use of sea water or brackish water will not be allowed, except in mass concrete (not reinforced).

### PROPORTIONING CONCRETE.

(12) Class A concrete shall consist of 1 part of cement to a total of 6 parts of fine and coarse aggregates, measured separately.

(13) Class B concrete shall consist of 1 part of cement to a total of 7.5 parts of fine and coarse aggregates, measured separately.

(14) Class C concrete shall consist of 1 part of cement to a total of 9 parts of fine and coarse aggregates, measured separately.

(15) Class D concrete shall consist of 1 part of cement to a total of 10.5 parts of fine and coarse aggregates, measured separately.

(16) Fine and coarse aggregates shall be measured by loose volume and struck measurement shall be used. Cement shall be measured by packed volume, the receptacles for each brand of cement being accurately gauged, and their contents determined by the Director.

(17) The proportion of fine to coarse aggregate will be determined from time to time by the Director, in accordance with the respective percentage of voids. The proportion of aggregates will be such as will in every case produce densest possible mixture. Neither the coarse nor the fine aggregate shall contain more than 45 per cent voids, and after the fine and coarse aggregates have been mixed in the proper proportion, the voids in the mixture shall not exceed 25 per cent. If the voids in the combined aggregates are more than 20 per cent, the proportion of cement shall be increased as per the following schedule: 20 per cent of voids, 100 per cent of amount of cement specified; 22.5 per cent of voids, 120 per cent of amount of cement specified.

(18) It is the intention of these specifications to secure concrete having a uniform compressive strength of 1,600 pounds per square inch, rather than concrete having a fixed amount of cement to a given volume of aggregates. No payment will be made for extra cement required, since the necessity for excess arises from the use of inferior aggregates.

## CEMENT TESTING—INTERPRETATION OF RESULTS.

### FINENESS.

*Requirements.*—92 per cent to pass No. 100 sieve; 75 per cent to pass No. 200 sieve.

*Interpretation.*—In considering the results of the fineness test, it must be remembered that fineness is not an end in itself, but only the means to an end, its purpose being to ensure the soundness and increase the strength of the material. Unless, therefore, the material is exceedingly coarse, it is generally unwise to reject a shipment on the fineness test alone, if it is otherwise satisfactory. The manufacturer should be notified, however, and if future shipments show no improvement, that brand should be prohibited on the work.

### SPECIFIC GRAVITY.

*Requirements.*—Not less than 3.10. If failure occurs, heat for thirty minutes at very dull read heat, and redetermine.

*Interpretation.*—With the exception of the test for soundness, there is probably no test in which incorrect or misleading inferences can be drawn so readily as in that of specific gravity. This is chiefly due to the fact that the test is comparative rather than absolute. For example, one cement may average a specific gravity of 3.16 and another 3.11. Now, a sample of the first testing 3.12 might be underburned or considerably adulterated, and yet be higher than a normal value of the second brand. For this reason an operator must have considerable experience with average values before he can accurately interpret the results of a single test. Again, an abnormally low value may be the result of excessive seasoning. Now, if this seasoning has not been sufficient to lower the strength below requirements, the cement is undoubtedly in far better condition for service than if it were fresh, because it will almost certainly be volume constant. The greatest difficulty that many consumers experience is in the securing of well-seasoned material, and yet testers of cement frequently reject such material merely because its specific gravity is low, thus defeating their own ends.

A sample of cement that tests below the average in specific gravity should be examined for adulterations and should also have tests made on dried and ignited samples; but if it is shown to be free from adulterations, sufficiently strong, and sound, it should never be rejected merely because its specific gravity may be somewhat below requirements.

The specific-gravity clause, however, should be a feature of every specification, in order that a cement proven to be underburned or adulterated may be rejected on its strength, even though it may pass the other tests.

SOUNDNESS.

*Requirements.*—Pats about 3 inches diameter, ½ inch thick at center and tapering to a thin edge, to show no signs of distortion, checking, cracking, or disintegrating, under (*a*) accelerated test, kept in moist air twenty-four hours, and in steam at atmospheric pressure, over boiling water for five hours, (*b*) normal tests, kept in moist air twenty-four hours and in air for twenty-eight days, or kept in most air twenty-four hours and in water for twenty-eight days.

*Interpretation.*—To properly interpret the results of the soundness tests requires large and varied experience, and is undoubtedly the most difficult phase of the testing of cement.

Although not infallible, it is safe to consider the results of the normal tests, i. e., twenty-eight days' exposure, assuming correct manipulation as absolute criteria of quality, and to reject all samples that fail to pass them.

If a sample fails in the accelerated test, i. e., exposure to steam for five hours, as typified by the boiling test, it is the safe course to hold the shipment for at least twenty-eight days, and then to make a second determination upon a fresh sample. If this second sample passes the tests, it shows that the additional seasoning has made the shipment entirely sound and fit for use. If the second sample fails, and the neat tensile strength shows any decided retrogression in twenty-eight days, the shipment should be considered as suspicious and probably unsafe, at least for the important parts of a structure. Generally, however, if all the other physical requirements are satisfied, and the boiling test alone fails, it is neither advantageous nor justifiable to reject the shipment, except, possibly, in a competitive test, in which case the samples passing the boiling test are to be considered preferable.

TIME OF SET.

*Requirements.*—Initial set, no appreciable indentation, under 1/12-inch diameter needle, ¼ pound weight, in not less than fourty-five minutes; final set, no appreciable indentation under 1/24-inch diameter needle, 1 pound weight in not to exceed 10 hours.

*Interpretation.*—On account of the approximate character of the determination, and the necessary presence of the personal equation, the requirements for setting should always be interpreted liberally. A mortar or concrete on actual construction will generally, on account of the wetter mixture, and the presence of the aggregate, require from two to four times as long to set as the test piece in the laboratory. Concrete for heavy construction usually requires about twenty minutes to be mixed and placed in the work, and the hypothesis that the concrete requires twice as long to set as the cement paste, a test of less than ten minutes initial set would show that the concrete had commenced setting before being tamped into place, and hence had been subjected to reworking, although not retempered. Cement mixed in a mortar box for bricklaying or similar purposes will often stand over an hour after mixing and before being used, and if this is allowed, the requirements for setting should be more rigidly adhered to. Generally, if the test of initial set is less than a half or a third of the time required to mix and place the material on the work, the shipment should be rejected, or held for further seasoning.

The determination for hard set is less important, and unless prolonged beyond all reasonable bounds, so that the progress of the work will be delayed, rejection on failure to pass this requirement alone is rarely, if ever, justifiable. Gross failure in this test will almost invariably be accompanied by failure in tensile strength, on which ground it may be rejected without question.

TENSILE STRENGTH.

*Requirements.*—Briquettes kept twenty-four hours in moist air and remainder of time in water, to develop—Neat cement: At seven days, 500 pounds; per square inch at twenty-eight days, 600 pounds per square inch. One to three mortar; at seven days, 200 pounds per square inch; at twenty-eight days, 275 pounds per square inch.

*Interpretation.*—Specifications for the tensile strength of cement usually stipulate merely that the material pass a minimum strength requirement at seven and at twenty-eight days, and the requirements, moreover, are so easily met that only a decidedly inferior cement will fail to pass them. It must not be understood, however, that the specification requirements should be raised, since many old and well-seasoned cements which make the best material for service might then be rejected. The proper grounds for the judgment of the tests of tensile strength are four in number: That both neat and sand briquettes shall pass a minimum specification at seven and twenty-eight days; that the neat value of seven days shall not be excessively great; that there shall be no retrogression in the neat strength between seven and twenty-eight days; and that the strength of the sand briquettes between these periods shall increase at least 10 or 15 per cent. It must, moreover, be remembered that the sand test is the true criterion of strength, and no cement failing in these tests should be accepted even if the neat results are excellent. If the conditions are reversed, however, the sand tests passing and the neat failing, it may be justifiable to permit the use of the material, provided there is no accompaying indication of unsoundness.

The reason that the strength of cement shall satisfy a minimum requirement is obvious. The objection to a high neat test at seven days is that it usually indicates an overlined cement, which is practically certain to developed a decided retrogression in twenty-eight days, and is also more liable to unsoundness. An abnormal amount of sulphate of line may also produce a similar effect. Portland cement tested neat in accordance with the method given and developing a strength in seven days of over 850 pounds should be looked upon with suspicion and generally ought to be held for the twenty-eight days' test before allowing it to be used. Cement showing a retrogression in the strength of neat briquettes between seven and twenty-eight days is not necessarily of poor quality, but it may be considered as inferior to those giving a good increase. On cements testing below 750 or 800 pounds at seven days, the lower the seven-day results, the more serious becomes any subsequent falling off in strength. If testing below 700 pounds at seven days, retrogression should mean rejection. In general, the greater the increase in strength between specification periods, the greater will be the strength ultimately attached. Thus, one testing 550 and 700 pounds at seven and twenty-eight days is usually preferable to one testing 750 and 800.

Cements failing to pass the sand requirements, or those not increasing in the sand strength, should not be accepted. Retrogression in sand strength is indicative, in the majority of cases, of ultimate complete failure.

A fair strength specification for Portland cement tested in accordance with the given method is 500 pounds for seven and 600 for twenty-eight days for neat briquettes, while those made of 1 part cement to 3 parts standard quartz should exceed 170 and 240 pounds at the same periods. If Ottawa sand is used, the sand requirements should be increased to 200 and 280 pounds. On these figures material passing the seven-day tests and failing at twenty-eight days is unsafe, while one failing at seven and passing at twenty-eight may be accepted. Additional security may be obtained by specifying a maximum neat strength at seven days (from 850 to 900 pounds), and an increase of 10 per cent in the sand strength between seven and twenty-eight days.

One other point that must always be borne in mind is that cement has no absolute strength, but the strength is that developed by a certain process of manipulation; if, therefore, the process varies, the results will also. For this reason the method to be employed in obtaining the results should be a feature of every strength specification. In many cases, after the rejection of a shipment, those furnishing the material have tests made by private laboratories and apparently disprove the original tests, but such tests deserve no consideration whatever, unless it be proven that the methods employed were identical in both cases and that both conformed to that stipulated in the specifications. An experienced operator may obtain almost any result from any cement by changes in the manipulation.

The following rules for the acceptance or rejecting of material on the results of the tensile test represent safe and conservative practice:

*At seven days.*—Reject on a decidedly low sand strength. Hold for twenty-eight days on low or excessively high neat strength, or a sand strength barely failing to pass requirements.

*At twenty-eight days.*—Reject on failure in either neat or sand strength. Reject on retrogression in sand strength, even if passing the twenty-eight days' requirements. Reject on retrogression in neat strength if there is any other indication of poor quality, or if the seven-day test is low, otherwise accept. Accept if failing slightly in either neat or sand at seven days and passing at twenty-eight days.

[NOTE.—Matter on interpretation of tests is quoted from "Practical Cement Testing," Taylor (Wiley & Sons).]

MANILA, *August 9, 1915.*

*Constructing Division Circular No. 158.*

SIR: Your attention is invited to bound copy of Bureau of Education Bulletin No. 37, School Buildings and Grounds, forwarded herewith under separate cover for your information and use. You are directed to place this bulletin in the permanent files of your office, and acknowledge receipt of same.

For the Director:

C. E. GORDON,
*Acting Chief Constructing Engineer.*

To all DISTRICT ENGINEERS, and
CITY ENGINEER, *Baguio.*

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MANILA, P. I., *September 4, 1915.*

*Constructing Division Circular No. 159.*

SIR: Supplementary to Provincial Division Circular No. 82, issued under date of October 15, 1912, attention is invited to the subjoined quotations from a communication received from the Collector of Internal Revenue:

"As the law now stands, merchants and common carriers are all subject to the fixed-privilege tax of ₱2, irrespective of the amount of business done. The percentage tax is paid by such persons on receipts over and above ₱200 per quarter, in which case a record must be kept.

"In deciding whether a person is subject to this fixed-privilege tax, this office cannot frame any precise rule. The question should be decided as particular cases arise. The occasional carrying of gravel or other material by a farmer or other person not generally engaged in carrying for hire, would hardly be sufficient to render such person liable as a common carrier. This would suggest, in cases where farmers or other persons engage in carrying materials to such an extent as to prove a subtantial source of gain or to affect business in the community, that they be considered as merchants or common carriers, as the case may be, and therefore subject to internal-revenue taxes."

Attention is also invited to Circular Letter No. 488, signed by the Collector of Internal Revenue and issued under date of April 15, 1915, and to Circular Letter No. 477, signed by the Collector of Internal Revenue and issued under date of January 13, 1915.

The above excerpts from a communication received from the Collector of Internal Revenue should be made known to all employees of the district engineer's office and to all merchants and common carriers subject to the provisions of such excerpts, and all possible assistance rendered to the local internal-revenue collectors.

For the Director:

C. E. GORDON,
*Acting Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,
SENIOR SUPERVISING ENGINEERS,
ENGINEERS ON SPECIAL DUTY, and
CITY ENGINEER, *Baguio.*

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BUREAU OF INTERNAL REVENUE,
*Manila, January 13, 1915.*

Subject: (1) Tax on motor spirits and mineral oils; (2) retail leaf tobacco dealers; (3) fixed and percentage taxes under schedule C; (4) butchers and bakers no longer exempt; (5) imported tobacco products; (6) error in Spanish translation; (7) retail tuba dealers; (8) daily sales book.

CIRCULAR LETTER NO. 477.

*To all internal-revenue officers and others concerned:*

1. *Tax on motor spirits and mineral oils.*—Standard Oil Company, the Texas Oil Company, and the Asiatic Petrolium Company, Ltd., which companies are the principal importers of motor spirits and mineral oils, other than lubricating oils, into the Philippine Islands, have made arrangements whereby all the taxes imposed by sections 45*bb* and 72*a* of Act No. 2339, as amended by Act No. 2432, on motor spirits and mineral oils on hand January 1, 1915, due from all of their agencies throughout the Philippine Islands, will be paid and accounted for in Manila. Internal-revenue officers outside of Manila will, therefor, refrain from collecting these taxes from any of the agencies of said companies.

2. *Retail leaf tobacco dealers.*—Payment of the tax imposed by paragraph (*m*) of section 45 of Act No. 2339, as amended, on retail leaf-tobacco dealers will be indicated by the issuance of B–14 license. The payment of this tax permits the sale of leaf tobacco or retail only at a fixed stand and at the place shown in the license. It does not cover the transactions of peddlers. If a man desires to sell leaf tobacco in more than one place he must pay the tax for each such place.

Before issuing a B–14 license to any person desiring to sell leaf tobacco at retail, the deputy provincial treasurer shall require the applicant to provide himself with a balance scale graduated in grams and capable of weighing up to 1 kilo, and a book in which the following data must be entered:

(1) On the debit side appear the date and weight in kilos of leaf tobacco purchased, and the name and address of the person from whom purchased.

(2) On the credit side entries must be made showing the date of each sale, the name and address of the buyer, and the weight in grams of the leaf tobacco sold. One kilo of leaf tobacco, which is the estimated quantity that an ordinary family will consume during one month, is the maximum amount that a retail dealer may sell at any one time to any one consumer and preserve his status as a retail dealer.

3. *Fixed and percentage taxes due under Schedule C.*—(*a*) *The fixed-privilege tax* of ₱8 per annum imposed by paragraph (*p*) of section 45 of Act No. 2339, as amended, upon merchants, common carriers, printers and publishers, contractors, warehousemen, and others subject to the payment of the percentage tax on business, will be collected in advance from every person or firm engaged in the business specified in sections 40, 42, 43, and 44 of Act No. 2339, as amended, irrespective of the amount of their sales or receipts, as the case may be. Persons engaged in public market places in the sale exclusively of domestic food products at retail and retail tuba and leaf-tobacco dealers are not taxable as "merchants" either for the fixed or for the percentage tax.

(*b*) As stated in section 38, as amended, the *percentage tax* is due only from those engaged in those businesses when the amount of their receipts or value of their sales is ₱200 or more per quarter.

(*c*) *The fixed-privilege tax* of ₱2 per quarter will be collected under the paragraph corresponding to the business subject to percentage tax, and will be collected quarterly in advance. The first quarter's fixed tax will be collected on a dummy coupon. If, at the end of the first quarter, it is found that the taxpayer is not subject to the percentage tax, notation of the amount of his sales will be made on the regular coupon for the first quarter. If his sales or receipts amount to ₱200 or more a quarter, the difference between the sum of ₱2 already paid for the first quarter as fixed tax and the percentage tax due will be collected on the regular coupon for the first quarter. In either case, the fixed tax of ₱2 for the second quarter will be collected on the regular coupon for the first quarter. The collection for the succeeding quarter will be made in the same manner, i. e., the percentage tax for the second quarter and the fixed tax for the third quarter will be collected on the regular coupon for the second quarter; the percentage tax for the third quarter and the fixed tax for the fourth quarter will be collected on the regular coupon for the third quarter; the percentage tax only will be collected on the regular coupon for the fourth quarter. The fixed tax for the first quarter of the next year will then be collected on a dummy coupon and the same procedure as outlined above will be followed.

(*d*) It has heretofore been the practice among certain internal-revenue officers to permit persons engaged in more than one business subject to the same rate of percentage tax to pay the tax on all their business on one license. Under the provisions of subsection (*p*) of section 45 of Act No. 2339, as amended, persons subject to tax under the sections relating to percentage taxes must pay to the fixed quarterly tax for each class of business in which they are engaged. Hereafter, therefore, the percentage taxes will be collected under the paragraphs to which they actually correspond and each class of business will be considered separately in ascertaining whether such person is liable to the percentage tax. For instance, a person engaged in business both as a contractor and as the keeper of a hotel should be required to pay the fixed-privilege tax and the percentage tax separately for each of these business.

(*e*) For administrative purpose, merchants traveling from place to place with their goods, i. e., peddlers of merchandise, will continue to pay under Schedule C, paragraph 5. Section 34 of Act No. 2339 states that the tax on business is payable for every separate or distinct establishment or place where business subject to the tax is conducted. In the case of peddlers or merchandise, each individual peddling outfit will be held to constitute a distinct establishment and a separate C–5 license must be procured for each such outfit. A peddler is not authorized upon the payment of the tax under C–5 to sell his goods at fixed stands. As the name implies, a peddler is one who transports his goods about the country seeking customers, in contradistinction to the merchant who maintains a fixed place or stand where he displays his goods and to which his customers resort. Payment of the proper C–1 tax must be made for each fixed stand. Booths, stalls, stands, or areas in markets, cockpits, or elsewhere where goods are displayed for sale are fixed stands.

4. *Butchers and bakers not exempt.*—Attention is invited to section 5 of Act No. 2432 which amends section 40 of Act No. 2339 by eliminating the exemption heretofore granted butchers and bakers from the tax imposed on merchants. Internal-revenue officers will take

immediate steps to notify all butchers and bakers in their respective districts that they are not longer exempt from the tax as merchants.

5. *No guias or stamps are required* on imported tobacco products. A B–9, B–12, or B–13 license, as the case may be, is sufficient to cover the sale of each products.

6. *Error in Spanish translation, section 35, Act 2339.*—In the first clause of section 35 of Act No. 2339, the printed Spanish copy uses the word "xigirá" instead of "eximirá." The first clause should therefore read: "El pago de un impuesto sobre el comercio y la industria no eximirá a la persona que lo ejerza de ningún otro impuesto * * *."

7. *Retail tuba dealers.*—In connection with paragraph 4 of Circular Letter No. 471 relative to the fixed tax on dealers in tuba, attention is drawn to the fact that while the payment of the tax as retail-tuba dealer not only covers sales at a fixed place of business, but allows a person to travel from place to place selling tuba without the necessity of paying the tax as a retail peddler of alcoholic and tobacco products (B–13) one license does not cover more than one distinct establishment or place where the business is conducted. In the case of peddlers, each individual traveling outfit constitutes a distinct establishment. Hereafter in issuing a B–7 (*a*) license, the deputy provincial treasurer will show on the face of the license whether same covers a fixed stand or a peddling outfit.

8. *Daily sales book.*—Paragraph 2 of Circular Letter No. 467 has been misinterpreted by a number of internal-revenue officers to mean that all merchants and manufacturers must keep a book in the form indicated by the model in said paragraph 2. While it is required that every merchant and manufacturer subject to the Schedule C tax shall enter in detail each day each of his sales that amounts to ₱50, if the merchant never makes a sale of ₱50 he has only to enter the daily aggregate amount of his sales, and in such a case the daily sales book formerly used is sufficient.

JAMES J. RAFFERTY,
*Collector of Internal Revenue.*

BUREAU OF INTERNAL REVENUE,
*Manila, April 15, 1915.*

Subject: (1) Sale of "Maltina" and "Beerine;" (2) common carriers owing but a single vehicle; (3) taxation and regulation of public vehicles by municipal councils; (4) collection of taxes from fish dealers.

CIRCULAR LETTER NO. 488.

*To all internal-revenue officers:*

1. *Sale of "Maltina" or "Beerine" requires B–7 license.*—The attention of all internal-revenue officers is drawn to the fact that certain fermented liquors such as "Maltina" and "Beerine," while they contain a very low percentage of alcohol, are, nevertheless, fermented liquors. Persons engaging in the sale of same should, therefore, be required to pay the privilege tax imposed by subsection (*j*) of section 45 of Act 2339, as amended (B–7).

2. *Common carrier owning but a single vehicle not required to keep a record of receipts.*—Paragraph 4 of Circular Letter No. 467 (12 Off. Gaz., 1893) regarding the records of sales and receipts to be kept by Schedule C taxpayers is hereby amended to read as follows:

"4. *Exceptions to above regulations.*—There shall be exempt from the requirements contained in paragraphs 2 and 3 hereof—

"(*a*) Any person or firm subject to a percentage tax, who keeps regular commercial books of account in English or Spanish containing all the data required to be entered in the books herein described, and

"(*b*) Any common carrier engaged in business exclusively outside of the cities of Manila, Iloilo, or Cebu, and whose receipts never reach ₱200 per quarter, who owns only one carromata, calesa, carretela, or bull cart.

"Any common carrier owning two or more vehicles of whatever kind will be subject to the provisions of paragraphs 2 and 3 hereof, unless the falls within the exemption contained in subparagraph (*a*) of this paragraph."

3. *Taxation and regulation of public vehicles by municipal councils.*—The attention of all internal-revenue officers is drawn to the fact that while a municipal council is authorized to tax and regulate public vehicles engaged in business within a municipality, it is not authorized to impose a license tax upon any vehicle coming into a municipality from others, but only upon vehicles of residents within the municipality. The mere passing through a municipality of a public carriage licensed elsewhere, even though it is in the habit of doing so at regular intervals, does not subject it to a similar license tax in such a municipality. In the case of owners of public vehicles not residing within the municipality, it is only when they engage in business within the municipality, and not between one municipality and other municipalities, that the municipal council may tax the business. Internal-revenue officers are instructed to observe any excess of authority in this respect and to report it at this office, inasmuch as the internal revenues have suffered in consequence of municipal authorities illegally exacting license taxes from common carriers not actually engaged in business within the municipality.

4. *Collection of taxes from fish dealers.*—It has been brought to the attention of this office that in certain provinces there is a general impression that dealers in fish are not subject to the payment of the merchants' tax. The only case in which dealers in fish are exempt is when the owner of the fish is engaged in public market places in the sale exclusively of domestic fish at retail (section 40 of Act 2339). The owner of a fish pond who sells his product to various retail dealers in market places is not himself exempt, even though the persons selling his product in the market places are exempt. All internal-revenue officers will take immediate steps to secure all payment of all current and back taxes from the fish dealers in accordance with the foregoing decision, and if necessary, criminal action will be resorted to to enforce compliance with the law. Internal-revenue agents will report to this office any failure on the part of deputy provincial treasurers to rigorously enforce the law in this respect.

V. CONCEPCIÓN,
*Acting Collector of Internal Revenue.*

ERRATUM.

The last line of subparagraph (*b*) in paragraph 2 of this circular letter should be changed to read: "carromata, calesa, carretela, bull cart, or small boat of the kind known as 'banca.'"

# APPENDIX B.

## AUTOMOBILES REGISTERED IN THE AUTOMOBILE DIVISION, BUREAU OF PUBLIC WORKS, FROM JULY 1 TO SEPTEMBER 30, 1915.

| Registry No. and type. | Owner's name and address. |
|---|---|
| 3875. Automobile | Honorata Fabian, Bocaue, Bulacan. |
| 3876. ....do | Hilton Carson, Baguio, Benguet. |
| 3877. ....do | Lim Ueco, 189 Juan Luna, Manila. |
| 3878. Cancelled. | |
| 3879. Automobile | Compania General de Tabacos de Filipinas. |
| 3880. ....do | Philippine Sugar Estate, Calamba, Laguna. |
| 3881. ....do | J. E. Douglass, care of Macleod & Co., Manila. |
| 3882. ....do | David Sommer & Co., Cebu, Cebu. |
| 3883. ....do | José Trinidad, 834 Rizal Avenue, Manila. |
| 3884. ....do | C. C. Stokely, U. S. Army, Cuartel de España. |
| 3885. ....do | Domingo Lao, 522 Elcano, Manila. |
| 3886. ....do | A. M. Brown, 1026 Taft Avenue, Manila. |
| 3887. ....do | Province of Occidental Negros. |
| 3888. ....do | Peregrino Uy Boco, 7 Renta, Manila. |
| 3889. ....do | Province of Bohol. |
| 3890. ....do | Roy J. Berry, 223 Gral. Luna, Manila. |
| 3891. ....do | Dean C. Worcester, Nagtahan, Manila. |
| 3892. ....do | A. J. Robertson, 880 M. H. del Pilar, Manila. |
| 3893. ....do | Sra. Francisco de Gutierrez, 827 M. H. del Pilar, Manila. |
| 3894. ....do | Marco & Ortili, Guinobatan, Albay. |
| 3895. ....do | H. E. Stafford, 124 Gral. Luna, Manila. |
| 3896. ....do | P. K. Gilman, Kneedler Building, Manila. |
| 3897. ....do | W. C. Bunnel, Army and Navy Club, Manila. |
| 3898. ....do | Enrique Barrera y Caldes, 202 Anda, Manila. |
| 3899. ....do | Mariano Veloso, Cebu, Cebu. |
| 3900. ....do | Arsenio Locsin, 674 Evangelista, Manila. |
| 3901. ....do | Province of Bulacan. |
| 3902. ....do | Tuan Calid, Dansalan, Mandaya, Mindanao. |
| 3903. ....do | Joseph E. Fox, 1099 R. Hidalgo, Manila. |
| 3904. ....do | Maximo Nubla Co Bong, 525 Azcarraga, Manila. |
| 3905. ....do | Aniceto Ruiz, 233 Carriedo, Manila. |
| 3906. ....do | Bureau of Agriculture, Manila. |
| 3907. ....do | Teodoro M. Kalaw, 515 Peñafrancia, Manila. |
| 3908. ....do | Juan de Leon, Manduriao, Iloilo. |
| 3909. ....do | Ramon A. Arevalo, 2792 Calle Herran, Manila. |
| 3910. ....do | Ana R. Vda. de Bischoff, 604 Vermont, Manila. |
| 3911. ....do | Alhambra Cigar and Cigarette Manufacturing Co., Manila. |
| 3912. ....do | Province of Pampanga. |
| 3913. ....do | Tan Chang Say, San Pablo, Laguna. |
| 3914. ....do | Dr. Manuel S. Guerrero, 7 A. Flores, Manila. |
| 3915. ....do | Compañia La Union, Tacloban, Leyte. |
| 3916. ....do | Do. |
| 3917. ....do | C. H. Halliday, Zamboanga, Zamboanga. |
| 3918. ....do | Sociedad La Union, Tacloban, Leyte. |
| 3919. ....do | H. H. Beisner, 282 Taft Avenue, Manila. |
| 3920. ....do | Marta Solano, Camilig, Albay. |
| 3921. ....do | Maj. Thos. L. Hartigan, 121 Arzobispo, Manila. |
| 3922. ....do | Geo. Kauffman, care of Manila Hotel, Manila. |
| 3923. ....do | José Villanueva, Batangas, Batangas. |
| 3924. ....do | Maria G. de Abril, 500 Rizal Avenue, Manila. |
| 3925. ....do | Manuel Earnshaw Co., Ltd., 223 Barcelona, Manila. |
| 3926. ....do | Pio Sian Melliza, 425 Misericordia, Manila. |
| 3927. ....do | Philippine Vegetable Oil Co., Manila. |
| 3928. ....do | Maria Araneta, Bago, Occidental Negros. |
| 3929. ....do | José Evangelista, Iloilo, Iloilo. |
| 3930. ....do | Philippine Vegetable Oil Co., Manila. |
| 3931. ....do | Geo. W. Cole, 17 Plaza Ferguson, Manila. |
| 3932. ....do | E. M. Hawk, 613 Calle Kansas, Manila. |
| 3933. ....do | Carranceja Motor Works, Daet, Ambos Camarines. |
| 3934. ....do | Casimiro Peña, Niugan, Malabon, Rizal. |
| 3935. ....do | Sulu Province, Jolo. |
| 3936. ....do | Aniceto Cardenas, 827 Elcano, Manila. |
| 3937. ....do | E. A. Kingcome, Cebu, Cebu. |
| 3938. ....do | L. T. Easton, 125 M. de Comillas, Manila. |
| 3939. ....do | Geo. A. Main, 614 San Marcelino, Manila. |
| 3940. ....do | H. A. Leslie, Aparri, Cagayan. |
| 3941. ....do | Dr. Cesar Mercader, Dumanjug, Cebu. |
| 3942. ....do | Ramon S. Araneta, La Palma de Mallorca, Manila. |
| 3943. ....do | W. E. Olsen, 27 Escolta, Manila. |
| 3944. ....do | Benjamin H. Williams, Fort Mills, Corregidor. |
| 3945. ....do | Venancio Concepcion, 566 Alix, Manila. |
| 3946. ....do | Theo. Nickelson, care of Philippine Sugar Estate, Calamba. |
| 3947. ....do | Benguet Commercial Co., Baguio, Benguet. |
| 3948. ....do | Felix Montenegro, Bais, Oriental Negros. |
| 3949. ....do | Celedonio Baylon, 2147 Azcarraga, Manila. |
| 3950. ....do | Ruperto Jalandoni, Jaro, Iloilo. |
| 3951. ....do | Wickham Quinan, care of Atlantic Gulf and Pacific Co., Manila. |
| 3952. ....do | B. Mayer, 64 Bustillos, Manila. |
| 3953. ....do | Justo Salgado, 12 Escolta, Manila. |
| 3954. ....do | Rosario R. Hidalgo, 677 Tanduay, Manila. |
| 3955. ....do | Vicente Ocampo, Biñan, Laguna. |
| 3956. ....do | Adriano Cué, 817 Santa Mesa, Manila. |
| 3957. ....do | Province of Zamboanga, Mindanao. |
| 3958. ....do | Espiridion Guangco, Hinigaran, Occidental Negros. |
| 3959. ....do | Juan Miciano, 309 Padre Faura, Manila. |
| 3960. ....do | Monsignor Gorordo (Bishop of Cebu), Cebu. |
| 3961. ....do | Maximo Rodriguez, Sariaya, Tayabas. |
| 3962. ....do | Tiburcio Medina Cue, 367 Juan Luna, Manila. |
| 3963. ....do | Dr. José Fabella, 1340 Herran, Manila. |
| 3964. ....do | Vicente Golingco, Tabaco, Albay. |
| 3965. ....do | Ricardo G. Lopez, 842 Santa Mesa, Manila. |
| 3966. Automobile | Ricardo Fernandez, 97 Legaspi, Manila. |
| 3967. ....do | Salvador V. del Rosario, 221 Soler, Manila. |
| 3968. ....do | Percy G. McDonnell, care of Cablenews Building. |
| 3969. ....do | Angel Roco, Naga, Ambos Camarines. |
| 3970. ....do | Alice T. Giovannini, 229 Concepcion, Manila. |
| 3971. ....do | Carl Defer, care of Ynchausti & Co., Manila. |
| 3972. ....do | Espiridion Guangco, Hinigaran, Occidental Negros. |
| 3973. ....do | C. R. Elliott, Cebu, Cebu. |
| 3974. ....do | Sergio Osmeña, 578 Alix, Manila. |
| 3975. ....do | Captain A. W. Barry, Camp Keithley, Mindanao. |
| 3976. ....do | Segundo Flores, Ligao, Albay. |
| 3977. ....do | Felix Robles, La Carlota, Occidental Negros. |
| 3978. ....do | Manuel Cuyugan, 130 M. H. del Pilar, Manila. |
| 3979. ....do | R. N. Hatrict, 2847 Herran, Manila. |
| 3980. ....do | Olimpio Guanzon, 605 San Nicolas, Manila. |
| 3981. ....do | Encarnación & Florentino, Lingayen, Pangasinan. |
| 3982. ....do | Felino Hizo, Bulan, Sorsogon. |
| 3983. ....do | Col. D. C. Shanks, U. S. A., Manila. |
| 3984. ....do | Ramon Sosteguer, Santa Barbara, Iloilo. |
| 3985. ....do | Manuel A. Montinola, Bacolod, Occidental Negros. |
| 3986. ....do | José A. Memije, 479 Real, Pasay, Rizal. |
| 3987. ....do | Siuliong & Co., 6 Ingreso, Manila. |
| 3988. ....do | L. McDonald, 115 Gral. Luna, Manila. |
| 3989. ....do | Venancio A. Nervisco, Lucena, Tayabas. |
| 3990. ....do | Maj. C. J. Manly, Army and Navy Club, Manila. |
| 3991. ....do | Lieut. Col. Joseph T. Clarke, U. S. Army, Manila. |
| 3992. ....do | La Germinal Cigar and Cigarret Factory, Manila. |
| 3993. ....do | Federico R. Bona, Tagudin, Mountain. |
| 3994. ....do | Generoso Gala, Tiaong, Tayabas. |
| 3995. ....do | Mariano Tuason, 6 Manga Avenue, Manila. |
| 3996. ....do | Province of Ambos Camarines. |
| 3997. ....do | Roman Lopez, 332 Vito Cruz, Manila. |
| 3998. ....do | P. K. Gilman, Roxas Building, Manila. |
| 3999. ....do | Bureau of Health, Manila. |
| 4019. Motorcycle | Department Engineer, U. S. Army, Manila. |
| 4020. ....do | Do. |
| 4021. Tricycle | Fred H. Howard, Company E, Thirteenth Infantry, Batangas. |
| 4022. Motorcycle | Philippine Constabulary, Manila. |
| 4023. ....do | Do. |
| 4024. Tricycle | E. K. Harper, Malolos, Bulacan. |
| 4025. Motorcycle | American Hardware and Plumbing Co., Manila. |
| 4026. ....do | Bureau of Science, Manila. |
| 4027. ....do | Burt P. Bean, Laoag, Ilocos Norte. |
| 4028. ....do | Louis Melin, 443 Solis, Manila. |
| 4029. ....do | Whitley Perkins, U. S. Navy, Cavite. |
| 4030. ....do | Owen M. Adams, 574 Reina Regente, Manila. |
| 4031. ....do | Philippine Constabulary, Manila. |
| 4032. ....do | Mountain Province. |
| 4033. ....do | Sergt. C. R. Gerber, 31 Cabildo, Manila. |
| 4034. ....do | Gregorio Serrano, 303 Raon, Manila. |
| 4035. ....do | John F. Harstine, Cebu, Cebu. |
| 4036. ....do | Sergt. George P. Chase, Medical Supply Depot, Manila. |
| 4037. ....do | Bureau of Agriculture, Manila. |
| 4038. ....do | Quartermaster Corps, U. S. Army, Manila. |
| 4039. ....do | Do. |
| 4040. ....do | Roy Dixon, 707 Wright, Manila. |
| 4041. ....do | Depot Quartermaster, U. S. Army, Manila. |
| 4042. ....do | Do. |
| 4043. Tricycle | Aquilino Farolan, 14 Progreso, Manila. |
| 4044. ....do | Simeon Ynarda, 2142 C. Makata, Manila. |
| 4045. Motorcycle | L. G. Klepinger, Lingayen, Pangasinan. |
| 4046. ....do | Province of Bulacan. |
| 4047. ....do | Segunda Sinson, Laoag, Ilocos Norte. |
| 4048. ....do | R. G. Kempski, Iloilo, Iloilo. |
| 4049. ....do | Pedro Abella, San Nicolas, Cebu. |
| 4050. ....do | H. C. Davidson, Manhattan Hotel, Manila. |
| 4051. ....do | D. E. Clancy, Calivo, Capiz. |
| 4052. Tricycle | R. O. Warrington, 225 Valenzuela, Manila. |
| 4053. Motorcycle | Ralph S. Frush, Jagna, Bohol. |
| 4054. ....do | J. McBean, 416 Madrid, Manila. |
| 4055. Tricycle | José Morin, 247 Florida, Manila. |
| 4056. ....do | American Hardware and Plumbing Co., Manila. |
| 4057. ....do | Rufino A. Domingo, Iloilo, Iloilo. |
| 4058. Motorcycle | Standard Oil Co., Manila. |
| 4059. ....do | Do. |
| 4060. ....do | James G. Wright, 18 Plaza Moraga, Manila. |
| 4061. ....do | D. C. Tatom, 51 Tupas, Cebu. |
| 4062. Tricycle | A. S. Watson & Co., 504 Aviles, Manila. |
| 4063. ....do | Emilio J. Basa, San Roque, Cavite. |
| 4064. Motorcycle | Vernon D. Gibson, Dagupan, Pangasinan. |
| 4065. Tricycle | Ricardo Enriquez, 118 Gandara, Manila. |
| 4066. ....do | Vicente Tiangco, Batangas, Batangas. |
| 4067. Motorcycle | Norman S. Pleasanton, Fort McKinley, Rizal. |
| 4068. ....do | George W. Wersabe, Cuartel de España, Manila. |
| 4069. Tricycle | José J. Eugenio, 77 Legaspi, Manila. |
| 4070. ....do | Province of Cavite. |
| 4071. Motorcycle | Walter B. Bost, Tagbilaran, Bohol. |
| 4072. ....do | Province of Bohol. |
| 4073. Tricycle | Maximo Constantino, 735 T. Alonzo, Manila. |
| 4074. Motorcycle | Jacinto Damian, 45 Dagupan, Manila. |
| 4075. Tricycle | Ah Hui, 329 Caballero, Manila. |
| 4076. Motorcycle | H. W. Besch, Capiz, Capiz. |

*Automobiles registered in the automobile division, Bureau of Public Works, from July 1 to September 30, 1915*—Continued.

| Registry No. and type. | Owner's name and address. |
|---|---|
| 4077. Motorcycle | Sidney S. Da Costa, Camp Keithley, Mindanao. |
| 4078 to 4099 Reserved for motorcycles. | |
| 4100. Automobile | Roy J. Berry, 223 Gral. Luna, Manila. |
| 4101. ....do | Do. |
| 4102. ....do | Leocadio Abeila, Legaspi, Albay. |
| 4103. ....do | S. Kendrick Everitt, jr., Manila Hotel. |
| 4104. ....do | Catalino Cruz, Batangas, Batangas. |
| 4105. ....do | Juan Maniquiz, Atimonan, Tayabas. |
| 4106. ....do | Alfredo Bustamante, Isabela, Occidental Negros. |
| 4107. ....do | Province of Lanao. |
| 4108. ....do | El Pekin, 15 Plaza Santa Cruz, Manila. |
| 4109. ....do | L. G. Salmon, Pasay, Rizal. |
| 4110. ....do | U. S. Quartermaster Department, Manila. |
| 4111. ....do | Benigno Goitia, 619 San Nicolas, Manila. |
| 4112. ....do | Carlos Dizon, 506 Salcedo, Manila. |
| 4113. ....do | Richard Campbell, judge, Court of First Instance. |
| 4114. ....do | Pio Trinidad, 834 Rizal Avenue, Manila. |
| 4115. ....do | O. F. Campbell, 666 Real, Manila. |
| 4116. ....do | José Bocanegra, Bais, Occidental Negros. |
| 4117. ....do | Tobias Wright, 11 Plaza Moraga, Manila. |
| 4118. ....do | Luis Atienza Bijis, Sariaya, Tayabas. |
| 4119. ....do | Luiz Marquez, Atimonan, Tayabas. |
| 4120. ....do | M. Sagasbarria, 161 Victoria, Manila. |
| 4121. ....do | Alba y Gallegos, Cebu, Cebu. |
| 4122. ....do | Do. |
| 4123. ....do | Simplicio del Rosario, 106 Gastambide. |
| 4124. Automobile | Ruperto Sarmiento, Dalaguete, Cebu. |
| 4125. ....do | Luis Alba y Villanueva, Cebu, Cebu. |
| 4126. ....do | Leandro J. Cabral, Hagonoy, Bulacan. |
| 4127. ....do | Dalmacio Olegario, 2141 Herran, Manila. |
| 4128. ....do | Ty Hoan Chay, 116 Hormiga, Manila. |
| 4129. ....do | José L. De Leon, Bacolor, Pampanga. |
| 4130. ....do | Filemon Acuña, Atimonan, Tayabas. |
| 4131. ....do | Kimpton Himes, 817 Santol, Manila. |
| 4132. ....do | José Moreno Lacalle, 114 Gral. Solano, Manila. |
| 4133. ....do | Alejandro E. Paterno, 645 Rizal Avenue, Manila. |
| 4134. ....do | Esteban Buenviaje, Oas, Albay. |
| 4135. ....do | Miguel Cañizares, Malolos, Bulacan. |
| 4136. ....do | Mariano Herrera, Sariaya, Tayabas. |
| 4137. ....do | John Helbig, 1282 M. H. del Pilar, Manila. |
| 4138. ....do | Mariano Veloso, Cebu, Cebu. |
| 4139. ....do | Vicente P. Genato, 629 Tanduay, Manila. |
| 4140. ....do | F. R. Caballero, 588 Alix, Manila. |
| 4141. ....do | Martin de los Reyes, 642 Rizal Avenue, Manila. |
| 4142. ....do | John Canson, 665 Gral. Luna, Manila. |
| 4143. ....do | Do. |
| 4144. Reserved. | |
| 4145. Automobile | Emiliano T. Tirona, Kawit, Cavite. |
| 4146. ....do | Manuel Garcia, 332 Palma, Manila. |
| 4147. ....do | Alba y Gallegos, Cebu, Cebu. |
| 4148. ....do | Manuel Roxas, 624 Echague, Manila. |
| 4149. ....do | José Ortiegas, Manila. |
| 4150. ....do | Otto Vorster, Singalong, Manila. |

# APPENDIX C.

## PROJECTS ACTIVE JULY 1, 1915.

| Provinces. | Roads and trails. | | | | Bridges and culverts. | | | | Provincial administration buildings. | | | Municipal administration buildings. | | | Prisons. | | | Schools. | | | Construction and operation. | | | | | | | | | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction. | Maintenance. | Repair. | Reconstruction. | Construction. | Maintenance. | Repair. | Reconstruction. | Construction. | Maintenance. | Repair and alteration. | Construction. | Reconstruction. | Maintenance. | Construction. | Repair and alteration. | Maintenance. | Construction. | Maintenance. | Repair and alteration. | Markets and tiendas. | Parks, grounds, and athletic fields. | Miscellaneous buildings. | Ferries. | Water systems. | Record vaults. | Quarries. | Telephone lines. | Electric-light plants. | Miscellaneous. | |
| Albay | 2 | 2 | | | 2 | | | | | 1 | | 1 | | | | | | 2 | | | | | | | | | | | | 1 | 11 |
| Ambos Camarines | 4 | 8 | | 1 | 2 | 1 | | | | | | | | | | | | 3 | | | 3 | | 1 | | | | | | | | 23 |
| Antique | 4 | 2 | | | 1 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | 8 |
| Bataan | 3 | 3 | | 2 | | | 1 | | | | | | | | | | | 1 | | | | | | | | | | | | 7 | 17 |
| Batangas | 5 | 3 | | | 1 | 1 | | | | | 1 | 1 | | | | 1 | | 4 | 1 | | 4 | 3 | | | 2 | | | | | 1 | 28 |
| Bohol | 3 | 3 | | | 4 | | | | | | | | | | | | | 5 | | | | | | | 1 | | | | | 1 | 17 |
| Bulacan | 1 | 4 | | | | | | | | | | | | | | | | 3 | | | 1 | | | | | | | | | | 9 |
| Cagayan | 1 | 2 | | | 2 | 1 | | | | | | 1 | | | | 1 | | 1 | 3 | | | | | 1 | | | | | | 8 | 21 |
| Capiz | 3 | 3 | 3 | 1 | 7 | | | | | | | | | | | | | 4 | | | | | 2 | 1 | | | | | | 1 | 25 |
| Cavite | 6 | 2 | | | 1 | | | | | | | | | | | | | 4 | | | | | | 1 | | | | | | 2 | 16 |
| Cebu | 6 | 2 | 1 | | | | | | | | | | | | | | | 4 | | | | 1 | 6 | | 2 | | | | | 4 | 26 |
| Ilocos Norte | 2 | 2 | | | | | | 1 | | | | | | | | | | 5 | | | 4 | | | | | | | | | | 14 |
| Ilocos Sur | 11 | 3 | 1 | | 2 | 1 | 1 | | | | | | 2 | | | | | 6 | | 1 | 3 | | 1 | 2 | 2 | | | | | 4 | 40 |
| Iloilo | 5 | 3 | 1 | | 1 | | | | | | | 1 | | | | | | 4 | | | | | | | 1 | | | | | 4 | 20 |
| Isabela | 4 | 2 | | | 2 | | | | | | | | | | | | | 1 | | | | | 1 | | | | | | | | 10 |
| Laguna | 2 | 4 | 1 | | 2 | | | 1 | | | | | | | | | | 14 | | | | 2 | 3 | | 1 | | | 1 | | 1 | 32 |
| La Union | 5 | 3 | | | 2 | | | | | | | 1 | | | | | | 7 | | | 2 | 1 | | 1 | | | | | | | 22 |
| Leyte | 2 | 2 | | | 11 | | | | | | | | | | | | | 5 | | | 2 | | 3 | | | | | | | | 25 |
| Misamis | 4 | 3 | | | 3 | | | | | | | 1 | | | | | | 2 | | | | | 1 | 1 | 1 | | | | | 2 | 18 |
| Nueva Ecija | 3 | 2 | | | 1 | | | | | | | | | | | | | 4 | | | 4 | 1 | | | | | | | | | 15 |
| Occidental Negros | 11 | 2 | | | 6 | | | | | | | | | | | | | | | | 4 | | | 1 | | | | | | 1 | 25 |
| Oriental Negros | 6 | 4 | | | 2 | | | | | 1 | | | | | | | | 3 | | | 4 | | | | 1 | | | 1 | | 1 | 23 |
| Pampanga | 4 | 2 | | | | | | 1 | | | | | | | | 1 | | 7 | | | 1 | 1 | | | | | | | | 1 | 18 |
| Pangasinan | 8 | 3 | | 5 | 2 | | | | | | | | 1 | | | | | 3 | | | 3 | | | 1 | | | | | | 2 | 28 |
| Rizal | 4 | 7 | 1 | | 5 | | | | | | | | | | | 1 | | 7 | | | | 1 | 5 | | | | | 1 | 1 | | 33 |
| Samar | 5 | 2 | | | 1 | | | | | | | | | | | | | 2 | | | | 1 | | 1 | | | | | | 2 | 14 |
| Sorsogon | 5 | 8 | | | 1 | | | | 1 | | | | | | | | | 2 | | | 1 | | | | | | | | | 11 | 29 |
| Surigao | 2 | 2 | | | | | | | | | | | | | | | | 4 | | 3 | | | | | | | | | | | 11 |
| Tarlac | 4 | 3 | | | | | | | 1 | | | | | | | | | 3 | | | 1 | | | | | | | | | 1 | 13 |
| Tayabas | 4 | 3 | | | 1 | | | | | 1 | | | | | | | | 2 | | | 5 | | 1 | | | | | | | | 17 |
| Zambales | 1 | 3 | | | 13 | | | | | | | | | | | | | | | | | 1 | 1 | | 1 | | | | | 2 | 22 |
| Total | 130 | 97 | 8 | 9 | 75 | 4 | 2 | 3 | 2 | 3 | 1 | 6 | 3 | | | 4 | | 113 | 4 | 4 | 42 | 12 | 25 | 10 | 12 | | | 3 | 1 | 57 | 630 |

NOTE.—The 57 projects under the caption "Miscellaneous" represent 5 surveys and investigations of roads, bridges, water systems, etc., 3 wharves, 3 dikes, 1 irrigation system, 1 auto line, 1 river control, etc.

# BUREAU OF PUBLIC WORKS

## ORGANIZATION

**WARWICK GREENE** (Absent), *Director of Public Works*
**E. J. WESTERHOUSE**, *Acting Director of Public Works*
**G. C. FENHAGEN**, *Consulting Architect*
**C. E. GORDON**, *Chief Designing Engineer*
**H. F. CAMERON**, *Senior Supervising Engineer, Mindanao and Sulu*

C. LINDSEY, *Assistant to the Director*
HAROLD N. GRAVES, *Chief Accountant*
J. R. KUYKENDALL, *Acting Property Clerk*

L. L. COOK, *Superintendent of Automobiles*
JOSE VENTANILLA, *Record Clerk*

## CONSTRUCTING DIVISION

**D. E. HENRY**, *Acting Chief Constructing Engineer*
**Wm. RADER**, *Acting Superintendent of Artesian Wells*

### DISTRICT ENGINEERS

| | |
|---|---|
| Brown, E. C. | Albay, Albay |
| Dandois, Chas. S. | Naga, Ambos Camarines |
| Segura, Valeriano | San Jose, Antique |
| Williams, A. D. | Baguio, Benguet |
| Francisco, Luis | Balanga, Bataan |
| Marshall, J. T. | Batangas, Batangas |
| Harrison, J. L. | Malolos, Bulacan |
| Vallarta, Julian | Tagbilaran, Bohol |
| Barry, R. L. | Tuguegarao, Cagayan |
| Bennett, C. R. | Cavite, Cavite |
| Sjovall, A. H. | Capiz, Capiz |
| Russell, Claud | Cebu, Cebu |
| Haley, A. E. | Cotabato, Cotabato |
| Phipps, C. E. | Davao, Davao |
| Glenn, R. V. | Iloilo, Iloilo |
| Baluyot, Sotero | Laoag, Ilocos Norte |
| Smith, E. D. | Vigan, Ilocos Sur |
| Gomez, Pastor | Ilagan, Isabela |
| Kasilag, Marcial | San Fernando, La Union |
| Barry, J. R. | Los Baños, Laguna |
| Clark, L. T. | Tacloban, Leyte |
| Meehleib, H. R. | Dansalan, Lanao |
| Caton, J. H. 3rd | Manila |
| Scheidemantel, L. W. | Cagayan, Misamis |
| Honska, W. B. | Calapan, Mindoro |
| Austin, A. W. | Cabanatuan, Nueva Ecija |
| Palmer, W. C. A. | Bacolod, Occidental Negros |
| Grosvenor, I. R. | Dumaguete, Oriental Negros |
| Halsema, E. J. | San Fernando, Pampanga |
| Morrison, C. G. | Lingayen, Pangasinan |
| Brown, L. R. | Pasig, Rizal |
| Hulse, S. W. | Catbalogan, Samar |
| Lilley, H. B. | Sorsogon, Sorsogon |
| Ines, Leon | Surigao, Surigao |
| Schenk, E. E. | Jolo, Sulu |
| Agcaoili, Romarico | Tarlac, Tarlac |
| Sylvester, A. T. | Lucena, Tayabas |
| Orosa, Vicente | Iba, Zambales |
| Cookingham, J. C. | Zamboanga, Zamboanga |